The FIELD ARTILLERY JOURNAL

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JANUARY-MARCH, 1915

JOURNAL *of the* UNITED STATES
FIELD ARTILLERY ASSOCIATION

Bethlehem Steel Co.

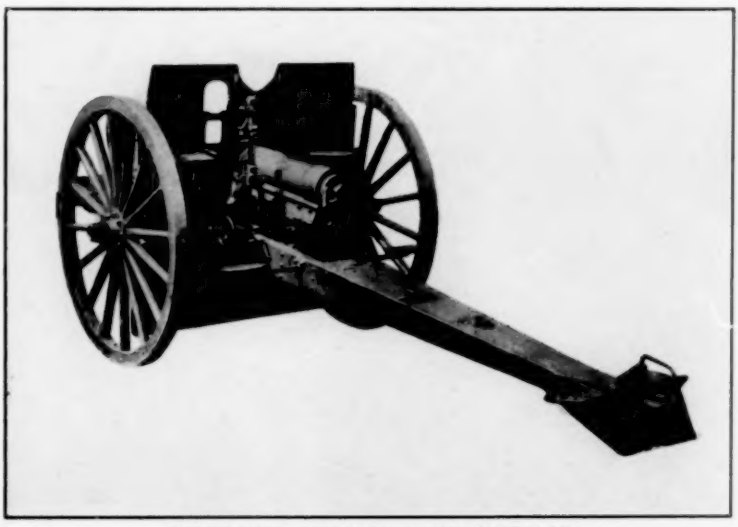
South Bethlehem, Pennsylvania 25 Victoria Street, London

Naval, Field and Coast Defence
GUNS and MOUNTS

ARMOR PLATE TURRETS PROJECTILES
FUZES CARTRIDGE CASES CASTINGS
FORGINGS SHAFTING RAILS
STRUCTURAL STEEL

Field Artillery

Guns Carriages Caissons Limbers Ammunition
a nd All Accessories



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The Field Artillery Journal

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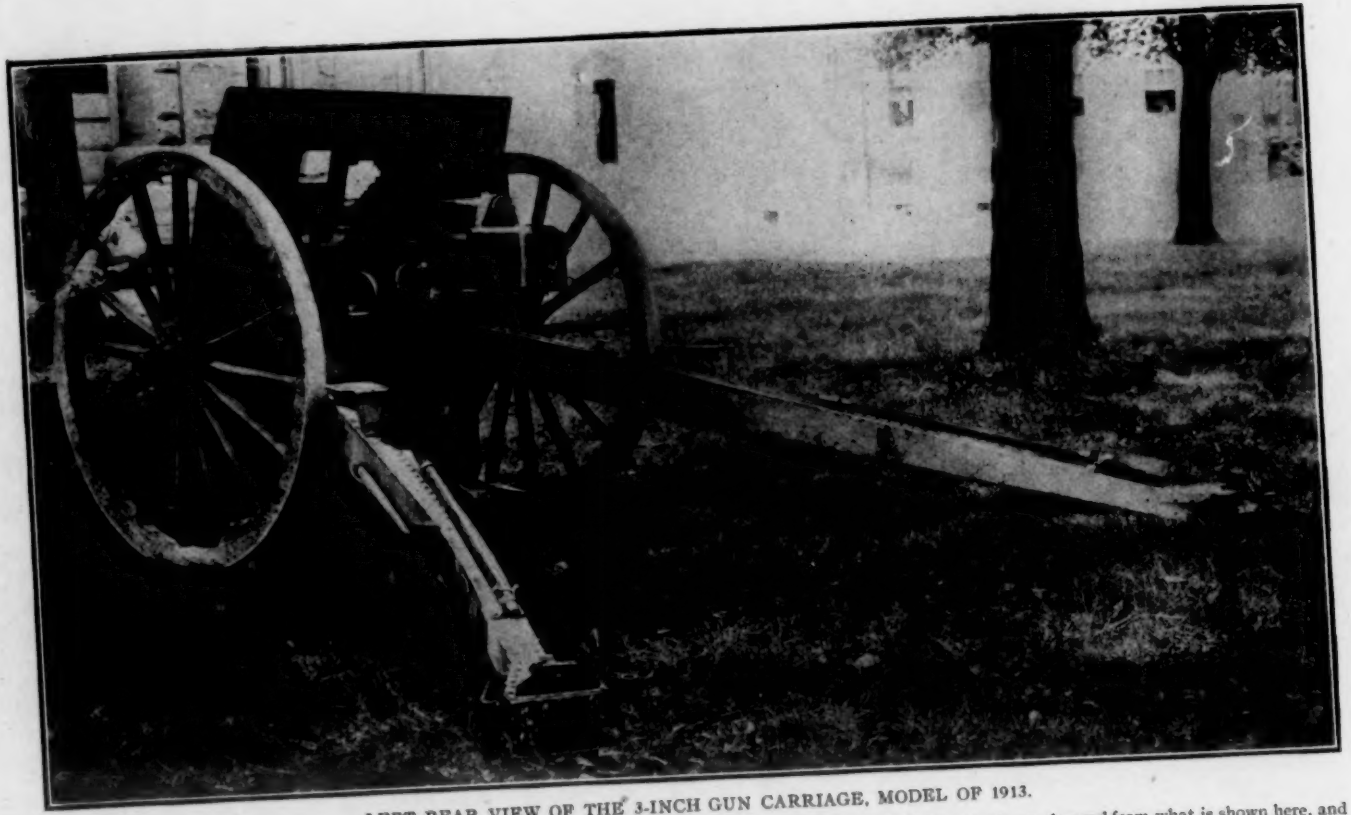

LEFT REAR VIEW OF THE 3-INCH GUN CARRIAGE, MODEL OF 1913.

The traverse hand-wheel, rocker elevating hand-wheel and panoramic sight are shown in place. The shield has since been changed from what is shown here, and is not cut away as much. The firing handle has been removed, but the firing handle bracket may be seen.

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EXTRACTS FROM LECTURES DELIVERED AT THE SCHOOL OF FIRE FOR FIELD ARTILLERY.

By Major Edward P. O'Hern, Ordnance Department.

December, 1914.

Recent Improvements in Our Service Artillery Matériel.

Model of 1913 3.8-Inch Howitzer and Carriage.

The 3.8-inch howitzer and carriage, Model of 1913, are similar in general to the 3-inch gun and carriage. Many of the parts of the two types, except the gun and recoil parts, will be interchangeable.

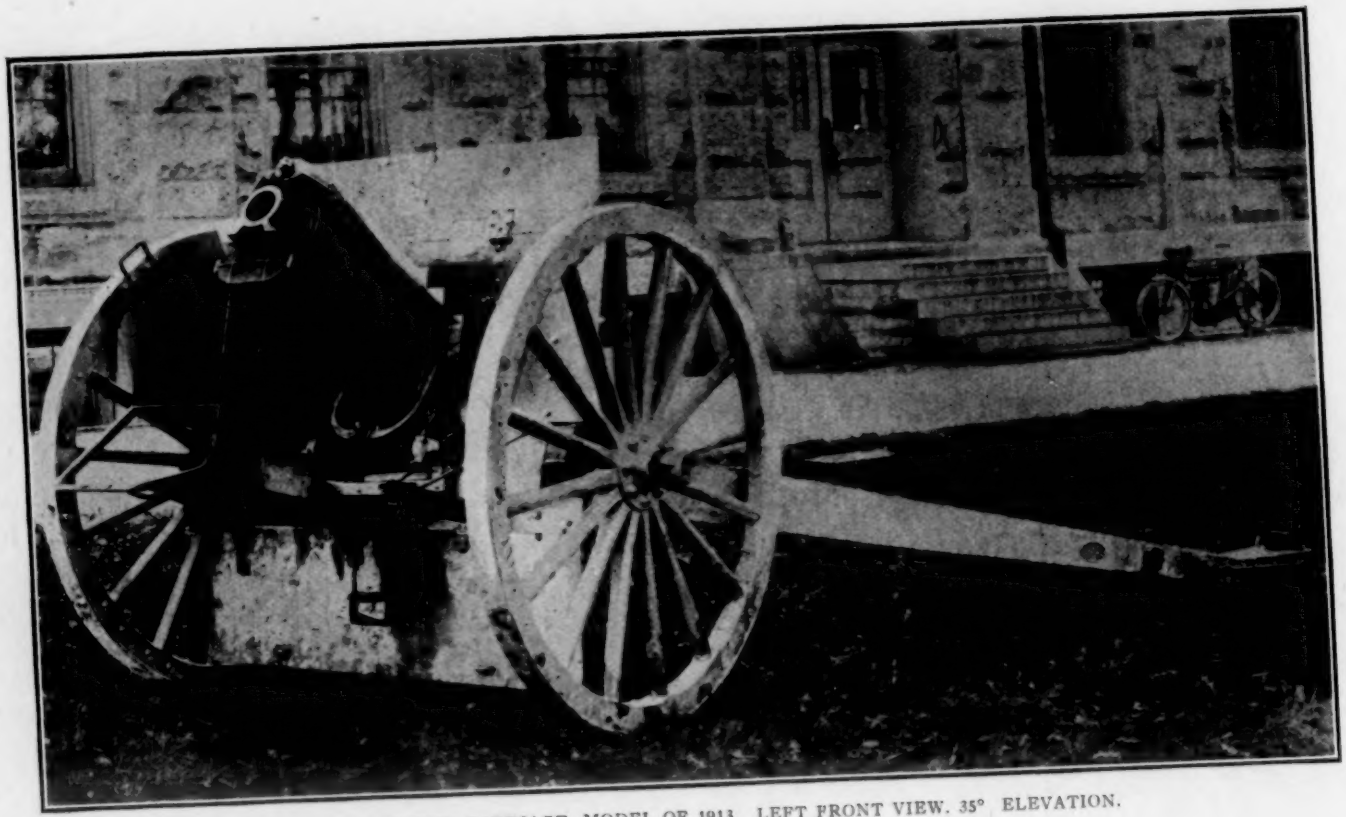
The limits of elevation for the howitzer are, however, not as great, being from minus 5 to plus 40 degrees without sinking the trail.

On account of the lower velocity, the howitzers are not well adapted for anti-balloon work; hence it was not considered necessary to provide for a greater angle of elevation than 40 degrees.

The recoil of the howitzer varies from 37 inches to 26 inches, depending upon the elevation, the shorter recoil being for the highest elevation. It has a total of 45 degrees traverse, the same as the 3-inch. The howitzer and carriage tested at Rock Island are being forwarded to Sandy Hook Proving Ground for more extended firing tests. Upon the completion of this test they will probably be forwarded to Fort Sill. There are now under manufacture eight batteries of 3.8-inch howitzers and carriages of the new type.

3-Inch Mountain Howitzer and Carriage.

The 3-inch mountain matériel has been under test by the 4th Field Artillery since last January. A preliminary report has been received stating in effect that the present carriage is considered too complicated and suggesting that a split trail carriage be furnished. A study of the subject in the Ordnance Office has indicated that



3.8 INCH HOWITZER CARRIAGE, MODEL OF 1913. LEFT FRONT VIEW. 35° ELEVATION.

such a carriage would be more complicated and would probably make necessary an additional pack.

A total traverse of 6 degrees is provided with the 3-inch mountain howitzer tested. On account of the general limitation as to size of parts it seems probable that not to exceed 25 degrees traverse could be provided with a split trail type of carriage.

The trail of the present mountain gun is so light that it can be readily moved by one man. It usually seats on the first shot, thus reducing the importance of providing for a wide traverse on the carriage. No extended description of this matériel is being given as it is understood to have been already the subject of a lecture before the School of Fire.

The following are a few of the general characteristics of this new matériel: weight of projectile, 16 pounds, muzzle velocity, 900 foot seconds; maximum range, 1800, 3300 and 5500 yards respectively for each of the three zones; semi-fixed ammunition; variable recoil; quick release to bring the gun into a convenient loading position without disturbing the aim.

The gun and carriage are carried in five packs as follows: Gun, cradle, top carriage and axle, trail, shields and wheels. Provision is made for carrying ninety-six rounds per gun, this being on eight mules, each carrying twelve rounds. Only ten rounds per mule have been carried in the 2-inch .95 matériel. The increase has been due to the abandonment of the wooden boxes or carriers previously used and the substitution of canvas carriers, the ammunition being in strong tin cases.

Artillery Wheels.

Experiments are being conducted with a number of proposed improvements in the construction of artillery wheels.

The most promising results are being obtained by the use of wheels having metal spoke shoes attached to the felloes thus supporting the end of the spokes.

Harness.

A possible change from steel collars to breast collars is in contemplation. The decision will depend upon the results of tests now being made in al regiments in continental United .States. The reports are due by March 1st.

Favorable report has been received from a limited test by a battery of the 3rd Field Artillery, in its work at Tobyhanna last summer.

7.6-Inch Howitzer Matériel.

There have been designed and are now under construction a 7.6-inch siege howitzer and carriage. This will fire a 240 pound projectile with a muzzle velocity of 1100 feet per second. At 40 degrees elevation a projectile having the present service type of head will reach a maximum range of approximately 9450 yards. By the use of a lighter weight projectile—190 pounds—equipped with a very long, sharp pointed head, a muzzle velocity of 1350 feet per second can be secured and a maximum range of 12,250 yards. In transportation the howitzer and the recoil cylinder are to be carried in one load and the remainder of the carriage in another. Each load will be about 8,000 pounds, the same as the present loads for 4.7-inch gun and 6-inch howitzer.

Light Weight Projectiles for 4.7-Inch and 6-Inch Howitzers.

There is under consideration the question as to the desirability of lighter weight projectiles in addition to those now supplied 4.7-inch and 6-inch howitzers, the purpose being to increase the maximum ranges. The extreme ranges can thereby be increased by from 20 to 30 per cent., an advantage which seems to me to justify the complication of carrying two weights of projectile.

9.5-Inch Siege Howitzer.

There are now in course of preparation designs for a 9.5-inch siege howitzer and carriage. This weapon will fire a projectile of 480 pounds with a muzzle velocity of 1,200 feet per second. It will have a maximum elevation of 40 degrees without sinking the trail, and will attain a maximum range of approximately 11,000 yards with the full weight projectile. With a reduced weight projectile the maximum range can be further extended. For transportation purposes it is expected to have the system sub-divided into five loads, four of them comprising the gun and carriage and one the equipment. The heaviest load is expected to be approximately 11,000 pounds.

Ammunition Trains.

There are now under manufacture sufficient caissons and other vehicles for three ammunition trains for 3-inch matériel. Each ammunition train comprises twenty-four caissons and limbers, one store wagon and limber, one battery wagon and limber, and one spare gun and limber.

Range Finder.

There has been adopted for service a 1-meter base range finder having the principles of the Goerz instrument tested at the School of Fire and recommended by the Field Artillery Board for adoption. Specifications have been prepared and an effort is about to be made to secure proposals for furnishing a supply to at least complete the equipment of the regular service. On account of the war in Europe it seems probable that they will have to be manufactured in this country. Twelve have already been issued. It is expected to carry them on an "off" artillery horse, fastened horizontally at each side of the horse. They can be carried short distances by being suspended in rear of the saddle.

The following are some of the principal requirements for these range finders: Power 15, field of view not less than 2.4 degrees; field must be flat, free from chromatic and spherical aberration, coma, and distortion; angle of site measuring device in which reading will be obtained by leveling the level device after the telescope is pointed at the target; must have convenient method of adjusting for infinity, self-contained internal adjuster preferred. Range finder is to be graduated up to 20,000 yards. Mean error in ten readings at each range must not exceed:

10 yards at	1,000
100 yards at	4,000
200 yards at	6,000
400 yards at	8,000
500 yards at	10,000

Weight of instrument must not exceed 25 pounds. One instrument of each lot of ten will be jolted for two hours in each of two positions, the jolting to be such as to give the instrument a drop of 2 inches under its own weight 30 times per minute. After adjustment the errors must not exceed those given above.

Each of the instruments that has been given the durability test

will be subjected to artificial rain for five minues and must show no leakage into the interior of the instrument.

Observation Instrument.

There has been adopted for service an observation instrument of the scissors type, to be made under specifications in accordance with the Goerz instrument tested at the School of Fire and recommended for adoption by the Field Artillery Board. A supply of these is about to be procured under the same conditions as described for the new range finder.

Observation Ladder for Field Artillery.

There has been developed at the Rock Island Arsenal and about to be forwarded to the Field Artillery Board for test, an observation ladder to be attached to a 3-inch field gun caisson. This ladder is of sliding and folding type, is provided with a shield, a seat for the observer, and a support for an observing instrument. It is made in three sections, the lower one hinged at the front edge of the caisson chest and the upper sections telescoping into the raised position. The height is adjustable between approximately 15 and 25 feet.

The ladder or observation tower is of steel construction and weighs, with its attachments, approximately 500 pounds. It is proposed to carry it on the caisson of the store wagon limber, this having less weight than a limber filled with ammunition. In tests at Rock Island three and a half minutes were required from the command to unlimber until the ladder was raised and a man was in position on top. The ladder was completely taken down and secured in position in three minutes, but it was stated that these times could be considerably reduced by experience and drill on the part of the personnel.

Machine Gun on Caisson.

Three-inch gun caissons are being equipped with means for carrying an automatic machine rifle pack outfit and seven boxes of small-arms ammunition; that is, 2,100 rounds. It is proposed to carry the gun, spare parts and one box of ammunition on the rear of the caisson chest, and to carry six boxes of ammunition on the front. The presence of the parts attached to the caisson door does not interfere with the opening of the door. It is proposed to carry two machine

OBSERVATION TOWER. RAISED POSITION.

guns and 4,200 rounds of ammunition for each battery. The equipment as worked out at the Rock Island Arsenal has been or is about to be forwarded to the Field Artillery Board for test. It has not, of course, been officially adopted.

Panoramic Sights.

There are under manufacture at Frankford Arsenal 138 panoramic sights of a new model—Model of 1913—differing from the former model—Model of 1904—in that there is an additional deflection scale on which deflection differences may be set off without disturbing the setting of the original deflection scale. Head prisms are also mounted so that they may be turned about a horizontal axis, thus permitting targets up to 300 mils above the horizontal plane being used as aiming points. This change will decrease the difficulty of selecting suitable aiming points.

Pocket Flash Lights.

There are being procured for issue to the service flash lights of pocket size. In this type a commercial flash light has been modified to prevent short circuiting from the exterior. The case is much stronger than the tubular flash light cases heretofore issued, and in addition affords better protection for the electric batteries.

Fuze Setter.

In view of the desire of the field artillery that a better fuze setter be developed, a great deal of thought has been given to that article of equipment within the past couple of years. It has resulted in various samples being forwarded to the Field Artillery Board for test and in other suggested changes not yet developed to the point justifying their consideration by the board. The types forwarded for test and not yet reported upon include one in which the fuze setter is rotated while the projectile is held fast; one in which a latch is provided to prevent the projectile from being withdrawn until accurately set; one in which an index is provided to indicate when the fuze is properly set, and the Greble fuze setter, involving a number of new principles. There has been very recently forwarded for test by the Field Artillery Board a bracket fuze setter procured from the Ehrhardt Co., presumably having all the latest and best features developed by that company. This fuze setter embodies the principle of setting the fuze by turning a crank. An

attempt was made to purchase a Krupp fuze setter and a French fuze setter, but the manufacturers declined to sell samples. Drawings of the Krupp fuze setter indicate that it differs from the Ehrhardt type chiefly in that only one turn of the crank is required to set the fuze, whereas two turns are required with the Ehrhardt type. In the Ehrhardt type the first turn of the crarnk in effect rotates the entire round until the pin in the fixed part of the round comes against a stop in the fuze setter. The second turn of the crank moves the time train ring the proper amount, depending upon the setting. In the Krupp fuze setter one or more extra sets of beveled gears are used, in order that the two parts of the system may turn in opposite directions; thus performing both the above functions with one turn of the operating crank. The greater simplicity of the Ehrhardt type is thought to more than justify the extra turn of the operating crank.

One of the proposed changes in the service bracket fuze setter as now being tested at Frankford Arsenal is an arrangement to make the corrector scale more plainly visible than at present. This is accomplished by making that scale a complete circle as on the hand fuze setters of the latest type. This avoids the necessity for a celluloid cover to protect the internal parts of the fuze setter, the corrector scale being wide enough to cover the slot for the pointer arm. The graduations on the corrector scale are on a circle of larger diameter than on the present bracket fuze setter, and will be much more easily read.

Another feature being tested out is the addition of a spring plunger to the operating handle of the corrector scale, so that a distinct click will be given for each turn of the handle. As each turn will correspond to one mil change in corrcetor setting, it will only be necessary for the operator to turn the handle five times at the command "Up 5" or "Down 5," counting the clicks to indicate when the proper change in setting has been made. This is a simple device and it is thought will facilitate quick changes in the corrector.

A third proposed change in the bracket fuze setter consists in making a casting which includes both the housing and the base, thereby simplifying the fuze setter by reducing the number of parts.

In order to give greater leeway in using fuze setters, under abnormal conditions of weather or ammunition behavior, corrector scales of hand fuze setters, models of 1912 and 1913, are being

extended to provide for an up correction of 75 degrees, the present limits being 25 degrees for guns and 30 degrees for howitzers. No change is being made in the limit of the down correction, or in that of the bracket fuze setters, those limits being 25 degrees up and down.

Strengthened Fuzes.

On account of the failures of the 21-second and 31-second fuzes to function due to a breakage of the stock before the fuze had time to function upon impact, greatly strengthened types have been developed and are now undergoing test at the Sandy Hook Proving Ground. The new types are thought to be at least twice as strong as the older ones. They are to be tested at direct and at inclined impact against steel plates, the soil conditions at the Proving Ground not being satisfactory for ground impact. Unless something unexpected develops at the Proving Ground, 25 rounds of each type now awaiting shipment at Frankford Arsenal will be forwarded to Fort Sill for further firing tests.

High Explosive Shrapnel.

There are now under manufacture at Frankford Arsenal approximately 130,000 rounds of 3-inch high explosive shrapnel, several lots which have already been completed. These are made in accordance with the general design of the Ehrhardt type, but have somewhat heavier cases and larger base charge, thereby securing increased ball velocity upon burst. There were recently assembled into complete rounds 10,000 high explosive shrapnel projectiles procured from the Ehrhardt Co. Their general behavior on test was excellent, but their efficiency as ordinary shrapnel is marred by the relatively low ball velocity, 191 foot seconds given by the base charge and by the light weight (138 grains) of the shrapnel balls.

Shrapnel Efficiency.

The relative efficiency of a shrapnel containing a large number of light weight balls as compared with one containing a smaller number of heavy weight balls has not, as far as I am aware, ever been thoroughly ascertained in this country, nor has the relative efficiency of a heavy case shrapnel as compared with a light case one containing a correspondingly greater number of balls. The decision seems

to hinge on the question as to what percentage of the balls in the two types will be effective under the usual conditions of fire. All the types will have sufficient ball density and sufficient ball energy for targets close to the point of burst, but the heavier balls and those with the greater velocity, will of course have greater effective range beyond the point of burst. In the design of the service shrapnel the principle of heavy case and heavy balls has heretofore been employed. It is proposed to manufacture and forward for comparative test in connection with the firings about to be undertaken at Fort Sill samples of shrapnel embodying the other principles. The French claim that high explosive shrapnel are undersirable, because they have neither the efficiency of common shrapnel nor that of high explosive shell within their respective spheres. The extent of the loss of efficiency as common shrapnel is indicated by the fact that in the Ehrhardt types the common shrapnel carries 49.8 per cent. of its weight in balls, whereas the high explosive type carries only 40 per cent., or about 20 per cent. less. The high explosive shrapnel when used as shell is undoubtedly much less efficient than high explosive shell, in at least as far as concerns mining effect.

It has been reported that the Germans are well pleased with the work of their high explosive shrapnel in the present war and that the French are well pleased with the work of their high explosive shell as will be referred to again later.

Aeroplane Bombs.

There was tested at the Signal Corps Aviation School at San Diego a few months ago a number of bombs or drop grenades suitable for use with aeroplanes. Some of these were a pear-shaped variety procured from a private manufacturer and some were an elongated cylindrical type manufactured at Frankford Arsenal. The weight per bomb was 15 pounds except that a few of the cylindrical types were of 50 pounds and of 100 pounds weight. The results with all types were satisfactory as regards safety and certainty of action. The pear-shaped type was, however, unstable in flight, wobbling more or less in dropping, with corresponding inaccuracy in point of fall. The flight of the elongated type was very regular and the target practice excellent, most of the bombs falling within 20 or 30 feet of the desired point on the ground

when dropped from an altitude of 2,000 feet. All types were provided with tail pieces to insure steadiness of flight.

Jump of Field Gun.

Firings were made at Sandy Hook Proving Ground some months ago with a view to determining how much if any the jump of the 3-inch Field Gun is affected by the following conditions:

(a) Spade at the edge of a hole in the ground into which it would drop after a small movement of the carriage.

(b) Effect of firing over a parapet close to the muzzle of the gun.

(c) Effect of omitting elevating mechanism.

The results clearly indicated that the jump was not appreciably affected by any of these conditions, a conclusion which seems rather surprising. It demonstrated that such jump as occurs is essentially due to the lack of coincidence between the center of mass of the recoiling parts and the axis of the bore. If these be made to coincide, as is being done with the latest types of guns, there will be practically no jump.

Accuracy Life of 3-Inch Field Guns.

Data as to the accuracy life of 3-inch field guns are limited to records from the Sandy Hook Proving Ground, where firings are normally slow, where there is a considerable number of excessive pressure rounds and some reduced charge rounds.

Under these conditions it has been found that guns become unsuitable for use in the ballistic tests of powder and fuzes after about 1,500 rounds. One gun after being fired 2,200 rounds had a short liner inserted to extend over the part of the bore that was most eroded. It has since been fired 604 rounds and is probably suitable for about 200 more before the accuracy becomes impaired; that is, for a total of about 800 rounds after relining. One gun, after firing 2,446 rounds, was completely retubed and has since been fired 2,250 rounds, and is probably good for 800 more before the accuracy becomes impaired. This particular tube has shown exceptional quality as to resistance to erosion. Accuracy firings gave mean deviations of 1.35 feet and 1.29 feet for fire round groups on a 1,000 yard target for a gun that had been fired 2,094 rounds and was considered by the Ordnance Board to be unsuitable for tests of powder and fuzes. A new gun generally gives mean variations

SIX-POUNDER BALLOON GUN CARRIAGE, MODEL OF 1910.

within 1 foot when fired under similar conditions. It is believed that a 3-inch field gun will show reasonable accuracy up to 3,000 rounds under battle conditions and that it will be fairly serviceable considerably beyond that point.

Anti-Aircraft Gun.

The illustrations herewith show a 6-pounder high velocity anti-balloon gun developed and tested about two years ago. The projectile weighs 6 pounds and is fired with a muzzle velocity of 2,400 feet per second. Difficulty was encountered in securing a time train fuze that would burn satisfactorily at that high velocity, so an order was placed abroad for one thousand rounds of ammunition which the Ehrhardt people claimed to be able to manufacture with proper functioning. The delivery of that ammunition has been stopped by the outbreak of the war in Europe.

The most promising projectile is a high explosive shrapnel in which the head explodes after having traveled 50 to 75 yards beyond the point of burst of the shrapnel proper. This gives two puffs of smoke to assist in ranging. It has been recently reported that the method in use abroad with common shrapnel is to fire a battery salvo with fuzes having slightly different settings. This gives four balls of smoke and greatly facilitates ranging.

Our Approved Project for Field Artillery Matériel and Ammunition, and Status of its Execution.

Note.—Although the text of the proceedings of the Greble Board was published in the July-September, 1913, number of the Field Artillery Journal, *the portions here quoted by Major O'Hern are reprinted because they are considered essential to a proper understanding of a subject which is of interest to every one who takes an intelligent interest in the military preparedness of the nation.*

Field Artillery Project.

The approved project under which the Ordnance Department and the other departments concerned have been operating in the supplying of guns, ammunition, etc., for field artillery is that recommended by the Board of Field Artillery and Ordnance Officers commonly known as the "Greble Board," convened in February, 1911.

The recommendations in that report were based on the assumption that in case of war with a first class power it would be necessary for the United States to raise *at once* a mobile force of approximately 450,000 men within the limits of continental United States. The field army was considered the smallest unit containing all the elements required in field warfare. The type adopted as a basis for decision as to Field Artillery was composed of three division and one auxiliary division, since designated as Field Army Troops; the Infantry component of the auxiliary division being one brigade. Based upon the Field Service Regulations and special directions of the Chief of Staff the number of guns per division was fixed at forty-eight—that is, one Artillery brigade of two regiments—while that for auxiliary divisions was fixed at eight guns per division, or twenty-four guns for a normal field army. This gave twenty-four heavy field pieces for a type field army in addition to the forty-eight guns in each division, thus making a grand total of 168 guns for a field army. The tables of organization based upon the Field Service Regulations show 2.82 guns per 1,000 Infantrymen in an Infantry division and 3.11 guns per 1,000 Cavalrymen in a Cavalry division; an average of 2.96 per 1,000 rifles or sabers.

Having in view the natural features of considerable portions of our own country, as well as that of the majority of those foreign countries in which operations of United States troops are most probable, it was prescribed that two divisions out of the total of eighteen be equipped with mountain howitzers.

Guns for Type Field Army.

For the type field army the Field Artillery of each of the first two divisions will consist of a brigade of two regiments, three battalions being equipped with 3-inch guns and the fourth battalion with 3.8 inch howitzers. Each of the first two divisions, therefore, will have nine batteries of 3-inch guns and three batteries of 3.8-inch howitzers. For the third division of the type field army the Filed Artillery will also consist of a brigade of two regiments, three battalions being equipped with 3-inch guns but the remaining one with 4.7-inch howitzers. In order to give the 4.7-inch howitzers approximately the same mobility as the 3-inch field guns, all vehicles of the 4.7-inch howitzer matériel in the third division will have eight-horse teams. The third division will thus have nine batteries of 3-inch guns and three batteries of 4.7-inch howitzers.

Field Army Troops.

For the auxiliary division or Field Army Troops of each type field army the Field Artillery will consist of one regiment of three battalions of two batteries each. Two of these batteries are to be equipped with 6-inch howitzers, two with 4.7-inch guns, and two with 4.7-inch howitzers. The 4.7-inch howitzer matériel with the Auxiliary Division will have six-horse teams instead of eight-horse teams. For the field army containing two divisions equipped with mountain howitzers, the third division is to be equipped with nine batteries of 3-inch field guns and three batteries of 4.7-inch howitzers.

Cavalry Divisions.

Each Cavalry division is to be provided with six batteries, a regiment, of 3-inch guns.

Insular Possessions and Panama.

Plans already perfected contemplated the assignment of the following mobile forces to stations outside the limits of Continental United States:

Philippines, 1 regiment ..... 6 batteries
Hawaii, 1 regiment ..... 6 batteries
Panama, ½ regiment ..... 3 batteries

The Board recommended that one-half the batteries in the Philippines be provided with 3-inch guns and one-half with 3-inch mountain howitzers, and that all the batteries in Hawaii and in Panama be equipped with 3-inch guns. It further recommended that one battery of 4.7-inch guns and one battery of 6-inch howitzers be provided in the Philippines. These recommendations have of course not as yet been wholly carried out.

Total Guns Required.

The Board pointed out that, in accordance with the estimates of the Chief of Ordnance almost one year would be required to manufacture the matériel for supplying a single field army, and that with few exceptions no war within the past forty-five years has had so long a duration. It was stated that since in a war with a first class power we would have to raise more than 450,000 troops, a small

reserve should be added to the guns specified above, and that all the guns recommended should be procured in time of peace. The proposed reserve amounted to sufficient guns for one additional field army, but no ammunition was to be provided for these extra guns. The 450,000 would be organized into six field armies and two Cavalry divisions.

Based upon the foregoing, the following table shows the amount and classification of batteries required for seven field armies, two Cavalry divisions and for use outside the limits of Continental United States:

Type of Gun.	United States.		Philippines.		Hawaii.		Panama.		Total.	
	Batteries.	Guns.	Batteries.	Guns.	Batteries.	Guns.	Batteries.	Guns.	Batteries.	Guns.
3 inch mountain heights..	24	96	3	12	.....	.....	.....	.....	27	108
3 inch field gun.....	183	732	3	12	6	24	3	12	195	780
3.8 inch Howitzer.....	36	144	.....	.....	.....	.....	.....	.....	36	144
4.7 inch Howitzer.....	35	140	.....	.....	.....	.....	.....	.....	35	140
4.7 inch field gun.....	14	56	1	4	.....	.....	.....	.....	15	60
6 inch Howitzer.....	14	56	1	4	.....	.....	.....	.....	15	60
Grand Total.....	306	1224	8	32	6	24	3	12	323	1292

54 Regiments

The total estimated cost of the project as regards guns, carriages, ammunition trains, harness, etc., but not including ammunition, which item will be considered later, is approximately $41,000,000. Of this amount there has been provided to date approximately $21,700,000, or 50 per cent., leaving $19,300,000 to be provided. Congress appropriated at the last session for this purpose a total of $2,725,000. If appropriations are continued at this rate, approximately seven more appropriations will for six field armies comprising 450,000 men complete the project. It is to be noted that the 1,124 guns in the total project will require approximately forty-eight regiments of field artillery. This is, however, a war basis and not a peace basis for the field artillery.

I wish to point out here that the Artillery of the regular service constitutes but one-sixth of that required for the first line of defense and that under present conditions only four regiments, or one-twelfth of the required artillery, is available within the limits of continental United States. There are available at present sixty-five batteries of organized militia to whom guns and equipment have been is-

sued, but many of which are far from a state of training satisfactory for field service.

If it be assumed that the six regiments of Regular Artillery and twelve regiments of Organized Militia be available for service in continental United States it will still be necessary to provide thirty regiments of volunteers to make up the required forty-eight regiments. Under these conditions it seems to me the most important work of the officers of the Field Artillery of the regular service is to assist in developing the Organized Militia to a reasonable plane of efficiency and to provide from the regular service a large number of officers of satisfactory training for service as field officers and captains of the regiments of volunteers which must be organized in time of emergencies.

Guns Completed.

The following table shows the number of guns and carriages of each type completed on November 1, 1914, the number on hand and under manufacture and the additional number required:

Type.	Completed Prior to Nov. 1, 1914.		On hand and under manufacture.		Additional Required.	
	Guns.	Batteries.	Guns.	Batteries.	Guns.	Batteries.
3 inch mountain	4	1	28	7*	80	20
3 inch field	500	125	568	142	212	53
3.8 inch Howitzer	28	7	60	15	84	21
4.7 inch Howitzer	30	7½	108	27	32	8
4.7 inch gun	42	10½	48	12	12	3
6 inch Howitzer	32	8	40	10	20	5
Total	636	159	852	213	440	110

* Six of these batteries are not actually under construction but the funds are being reserved for them.

Ammunition.

The Greble Board announced the following principles as those which governed in leading to a final recommendation as to what ammunition and ammunition trains should be provided:

That, for the 4.7-inch and 6-inch howitzers, the number of rounds to be kept in the Advance Supply Depot be fixed at double the number on wheels with the troops. Inasmuch as the extensive employment of heavy field artillery matériel is, in general, the result of a very considerable resistance, bringing about a combat of several days' duration, it was believed that ample time would be afforded

to make more or less elaborate arrangements, and that, as a consequence, the plan recommended would assure a sufficient supply of ammunition for the heavier howitzers.

Spare guns and limbers should be attached to ammunition trains so that disabled matériel may be replaced. The number of such guns should be limited and the proportion should vary approximately inversely as the number of guns of the several types available for the firing line, since the fewer the guns the more serious the disabling of a single one.

Composition of Ammunition Trains.

Based upon the above principles the Board recommended that the part of the ammunition train of each division and of each auxiliary division which carries artillery ammunition consist of one battalion of three ammunition batteries. Except for those divisions equipped with mountain howitzer matériel, each ammunition battery will comprise twenty-four caissons and limbers, one store wagon and limber, one battery wagon and limber, one spare gun and limber, and such supply wagons as may be necessary. For the divisions other than those equipped with mountain howitzers, the first ammunition battery will be equipped with caissons, etc., of the 3-inch field gun type; the third ammunition battery will be equipped with caissons, etc., either of the 3.8 or 4.7-inch howitzer type, according to the armament of the particular division; the second ammunition battery will be a mixed battery, one-half of the caissons and all other artillery vehicles being of the type for the 3-inch field gun, the remaining caissons being of the 3.8 or 4.7-inch field howitzer type. For auxiliary divisions, one ammunition battery is equipped with caissons, etc., for the 4.7-inch howitzers; one with caissons, etc., for the 4.7-inch gun; and one with caissons, etc.; for the 6-inch howitzer. Efficient organization requires that each battery be commanded by a captain, and be divided into two half batteries, of twelve caissons each, commanded by lieutenants; that each half battery be divided into three platoons, of four caissons each, commanded by sergeants, and that each platoon be divided into two sections, of two caissons each, commanded by corporals. Cannoneers should be provided for handling ammunition at the rate of two men per caisson. It may be pointed out that the above organization facilitates in every way the supply of ammunition. For example, the half battery contains a number of caissons exactly equal to the number of guns in a battalion, the half battery is the appropriate unit to carry out the actual supply of a battalion in action; similarly the platoon is the appropriate unit for supplying an isolated battery in action.

The Board considered it is a fundamental principle that the ammunition supply should be carried on automatically from rear

to front. It is, therefore, necessary to provide the ammunition battalions with a personnel destined to maintain the necessary communication with the firing batteries.

Ammunition for Mountain Artillery.

The following was the Board's recommendation concerning the ammunition supply for divisions equipped with mountain artillery matériel:

All of the ammunition accompanying divisions equipped with the 3-inch Mountain Artillery matériel should be carried on pack mules. This condition limits the amount of ammunition which can be carried. It is believed, however, that it is practicable to carry 212.5 rounds of ammunition for each 3-inch mountain howitzer and that this amount is sufficient, if consideration be taken of the fact that the terrain in which mountain artillery is usually called upon to operate limits, to some extent, great expenditures of ammunition. Of the 212.5 rounds, 100 should be carried in the ammunition train. This arrangement will permit limiting the personnel of the brigade of Field Artillery, forming a part of the division, to approximately the same number as now prescribed by Field Service Regulations for brigades equipped with the 3-inch field gun.

Ammunition for Horse Artillery.

In order to reduce the load for Horse Artillery with Cavalry divisions it was recommended that the limbers of horse batteries be not loaded with ammunition. This reduces the number of rounds per gun carried with the battery from 364 to 212, the saving in weight being about 666 pounds per vehicle. To further increase the mobility of Cavalry divisions, it was recommended that the portion of the ammunition train of the Cavalry division which carries Field Artillery ammunition be abolished. To compensate for the less number of rounds carried, the number to be maintained at the advance supply depot for each gun of the Horse Artillery is double that maintained for Field Artillery.

The following table shows the number and distribution of rounds per piece which should be available under the approved scheme at

the commencement of a campaign and should be so maintained during its progress:

	3-inch mountain Howitzer	3-inch Gun	3.8-inch Howitzer	4.7-inch Howitzer	4-inch Gun	6-inch Howitzer
On wheels and packs	212½	464*	312	180	336	168
In advance supply depots	212½	464	312	360	336	336
At base or in arsenals	425	928	624	540	672	504
Total available	850	1856†	1248	1080	1344	1008

* This includes 3 caissons with battery and one with ammunition train. For horse artillery this number is 212.
† For cavalry divisions the number of rounds per piece is 1284.

Ammunition Supply to be Provided.

The following table shows the ammunition to be provided in accordance with the foregoing scheme for six field armies and two Cavalry division:

	3-inch mountain Howitzer	3-inch Gun	3.8-inch Howitzer	4.7-inch Howitzer	4.7-inch Gun	6-inch Howitzer
Rounds per piece	850	1,856*	1,248	1,080	1,344	1,008
Pieces to be supplied	96	624	120	120	48	48
Total rounds to be supplied	81,600	1,130,688a	149,760	129,600	64,512	48,384

* Forty-eight guns for cavalry divisions at 1,284 rounds per piece are included. *Total*, 1,604,544 rounds.

This table does not include ammunition for guns in insular possessions. In order to provide for these guns at the same rate as for those in Continental United States, the total number of rounds should be increased by 10,200 rounds for 3-inch mountain howitzers, by 89,088 rounds for 3-inch field guns, by 5,376 rounds for 4.7-inch field guns, and by 4,032 rounds for 6-inch field howitzers. Grand total, 1,713,240 rounds.

The total estimated cost for the 1,713,240 rounds of ammunition required in accordance with the foregoing project is approximately $23,700,000. Of this amount there has been provided to date approximately $7,400,000, thus leaving to be provided $16,300,000. The value of the ammunition allowance for the guns on hand and under manufacture is approximately $19,000,000. The ammunition on hand and under manufacture is therefore approximately 38 per cent. of that required for the guns on hand and under manufacture and approximately 31 per cent. of that needed for the

total project. Congress at the last session appropriated a total of $4,200,000 for the procurement of Field Artillery ammunition. If the same sum be hereafter appropriated annually, the ammunition supply for the entire project will be completed with four more appropriations.

Status Ammunition Supply.

The following table shows the status of the mobile ammunition supply on November 1, 1914, as regards the number of rounds completed ready for issue, the number on hand and under manufacture, the shortage for the guns on hand and under manufacture, and the shortage for the entire project:

Type	Rounds Completed	On hand and under Manufacture	Shortage for Guns on Hand and under Manufacture	Shortage for Entire Project
3-inch mountain	3,798	3,814	19,986	87,986
3-inch field	133,612	500,909	545,875	718,867
3.8-inch Howitzer	16,130	16,500	58,380	133,260
4.7-inch Howitzer	14,375	23,122	93,518	106,478
4.7-inch gun	10,905	16,711	47,801	53,177
6-inch Howitzer	11,909	16,980	23,340	35,436
Total	190,729	580,098	794,262	1,135,204

In addition to the supply shown in the foregoing table, approximately 23,000 rounds of 2.95-inch ammunition are on hand or under manufacture. There are also on hand approximately 21,800 rounds of ammunition for 5-inch siege guns and 17,400 rounds for 7-inch howitzers.

Of the ammunition referred to above approximately the following quantities are outside the limits of Continental United States:

52,977 rounds of 3-inch (field).
20,805 rounds of 2.95-inch (mountain).
12,034 rounds of 5-inch (siege).
10,016 rounds of 7-inch howitzer.
3,500 rounds of 4.7-inch gun.

The value of the ammunition allowance for the mobile artillery guns in the hands of the regular troops and militia is about $7,250,000, which sum is very close to the total sum thus far provided for the manufacture of ammunition.

The present output of ammunition at Frankford Arsenal is about a thousand rounds per day. It is expected to increase this output shortly to 1,500 rounds and to complete by September 1st next, nearly all that under manufacture.

Capacity to Manufacture Field Artillery Ammunition.

The following table shows the estimated monthly capacity of the Frankford Arsenal for the manufacture of mobile Artillery ammunition, working on a war basis of twenty-four hours per day, together with that of such private manufacturers as have heretofore done such work or are now installing plants for that purpose.

Plant	Shrapnel	Shell	Remarks
Government Plant..	27,500	7,500	Complete rounds plus 18,750 fuzes.
Private Manufacturers, complete rounds	80,000	20,000	
Private Manufacturers, projectiles without fuzes.	12,500	17,500	
Total complete rounds.....	107,500	27,500	Shrapnel and shell, 135,000.
Total projectiles without fuzes.....	12,500	17,500	Shrapnel and shell, 30,000.
Grand total.....	120,000	45,000	Shrapnel and shell, 165,000.

The above table covers all the plants now installed or nearing completion, but there is reason to believe that other plants are about to take up this work. With the present capacity of 135,000 complete rounds per month from all sources, approximately one year would be required, including the time necessary to get under way, to supply the 1,135,204 rounds needed beyond those on hand and under manufacture to complete the supply for the 1,282 guns required for the first line of defense. The most serious factor in our situation is the small initial supply and the considerable time that would elapse before deliveries in large quantities could be commenced, although adequate facilities might be later developed.

Percentage of Shell and Shrapnel.

The following are the prescribed percentages of shell and shrapnel for service mobile artillery ammunition, approved by the Secretary of War May 23, 1914:

2.95-inch and 3-inch Mountain Howitzer, 3-inch Field Gun and 3.8-inch Howitzer ..... } All H. E. shrapnel.

If no shrapnel be issued	25% H. E. shell; 75% common shrapnel.
4.7-inch gun	40% H. E. shell; 60% common shrapnel.
4.7-inch Howitzer	33% H. E. shell; 67% common shrapnel.
6-inch Howitzer	67% H. E. shell; 33% common shrapnel.

European Field Artillery Matériel and Developments of the Present War.

Field Guns and Ammunition.

All the European countries concerned in the present war use long recoil shielded guns except that some of the Russian guns are probably without shields. For the principal weapon all countries except England use a gun of 2.95-inch or 3-inch caliber. The British older guns are 3-inch caliber, but the newer ones are 3.3 inches. Except the British and French all weights of projectiles are between 14.3 and 15 pounds The British 3-inch weighs 12½ pounds and the 3.3-inch, 18½ pounds. The French 2.95-inch shrapnel weighs 16 pounds and the shell 11½, both being of about the same exterior dimensions. The weight of shrapnel balls varies from 139 grains in the Krupp, Ehrhardt and Austrian types to 165 in the Russian, 170 in the British and 185 in the French. The weight of our shrapnel ball is 167 grains, this being about the mean of the above values.

High Explosive Shell.

The French and Belgians differ from the Germans, and probably from the rest of the allies in having a large capacity, thin-walled high explosive shell for use in the 2.95-inch field gun in comparison with a small capacity thick-walled type. The French carry approximately 1.8 pounds of explosive in the 11½ pound, 2.95-inch shell, whereas the Germans as do we, carry only about one-half pound in a 15 pound projectile. Our experiments have indicated that a larger charge is not advantageous, because it reduces the weight of metal available and breaks the shell into such small fragments, almost dust, that these have little effective range. As a result of Fort Riley tests of some years ago, the Field Artillery Board expressed the view that a 3-inch shell could not be

made effective for mining purposes. All our experiments have indicated that a thick-walled shell is more efficient for other purposes, the larger fragments being effective to considerable distances. At the outbreak of the present war the French carried in the 3-inch batteries 50 per cent. of shell and 50 per cent. of common shrapnel. Reports have been received indicating that the shell have proved so effective that battery commanders are now asking for nothing else. In the 95 pound, 6-inch howitzer shell, the French carry 30 per cent., about 28½ pounds of melinite—the high explosive in general use in their projectiles. This explosive is a mixture of picric acid and nitro-cellulose, nitro-benzol, or similar material. The British high explosive, lyddite, is also presumed to be picric acid with some other compound of the same general character as used in melinite. The Germans are believed to use trinitrotoluol or trotyl as a bursting charge, as we do in our mobile artillery high explosive shell and shrapnel.

The Germans have in use for each of the large caliber guns and howitzers two types of high explosive shell, one of these being of small capacity—3 to 4 per cent.—and the other of large capacity—18 to 20 per cent.—bursting charge. One of these is presumed to be for use against personnel and the other for mining effect. The bursting charge in our howitzer projectiles is intermediate with respect to these values, being about 5.5 per cent. for the 3.8-inch and 4.7-inch, and 11.5 per cent. for the 6-inch.

We are about to take up the development of a light weight large capacity, probably long pointed, type for at least the 4.7-inch and 6-inch.

French High Explosive Shell.

The special interest which attaches to the French high explosive shell, appears to justify some extended description. It carries a point fuze which is not inserted until just prior to firing. The body of the projectile is very thin walled, thus enabling the shell to carry about 16 per cent. bursting charge in a 3-inch shell and about 30 per cent. in a 6-inch howitzer shell. The large capacity type was adopted for the 3-inch gun in 1900, but was not issued to the service until three or four years later. As late as about one year ago the shell was accepted more or less indifferently by artillery officers, only twenty rounds per battery being issued for the annual target prac-

tice. As a result of tests conducted about that time, its efficiency in the attack of shielded batteries and other targets was so well established that the percentage to be carried was increased from twenty-five to fifty. On account of its light weight, about 11.7 pounds, it has the high muzzle velocity of 1,920 foot-seconds. It is provided with a delay-action fuze and is expected to secure results chiefly by a burst after ricochet, thus exploding from three to six feet above the ground. Tests in this country have indicated that such action cannot be secured under all conditions of fire. It was found that at long ranges and in soft ground at shorter ranges the shell buried itself and exploded harmlessly.

Organization, German Field Artillery.

The following information giving the general organization of the German field artillery is believed to be reliable.

A German army corps with an approximate strength of 45,000 men—includes two brigades of artillery as does our field army which is more than 50 per cent. greater in size. Each brigade in the German service comprises two regiments of two battalions of three batteries of six guns each. This conforms to our organization, except for the use of six-gun batterries. A report has been received indicating that the Germans are now changing to a four-gun basis, as has heretofore been the organization of their heavy field and siege artillery, but I cannot vouch for the accuracy of that report. Of these eight battalions with an army corps, six battalions, of eighteen batteries, or 108 guns, are 2.95-inch, and two battalions, of six batteries, or thirty-six pieces, are 4.1-inch howitzers. Further, each army corps has in addition two battalions, or six batteries, or twenty-four 6-inch howitzers. This makes up a total of 168 guns for 45,000 men, or 3.79 guns per thousand of total strength, not rifle and sabers. There are at the disposal of army headquarters, for use in the field against heavy intrenchments and forts, a number of 8.3-inch mortars and heavy 6-inch long range guns. Of each of these there are two battalions of three batteries of four guns each. That is, there are twenty-four 8.3-inch mortars and twenty-four heavy 6-inch guns; thus making forty-eight guns at the disposal of army headquarters. If it be assumed that an army comprises two army corps, this would add twenty-four guns to each army corps, making 192 guns, or

approximately 4.3 guns per thousand men, as compared with our average of 3.06 for our organization.

It was stated that the German field artillery matériel was chiefly of Ehrhardt design and includes the use of panoramic sights, scissors observing instruments, and range finders of the general types in use in our service or now being manufactured for that purpose. The field artillery matériel includes the following types and calibers, of which the 2.95-inch and 4.1-inch guns and 6-inch howitzers are the most important in field operations:

7.5	cm. =	2.95	inches, field gun.
10.5	cm. =	4.1	inches, field howitzer.
10.5	cm. =	4.1	inches, heavy field gun.
15	cm. =	5.9	inches, heavy field howitzer.
21	cm. =	8.3	inches, siege mortars.
28	cm. =	11	inches, siege howitzer (Krupp).
32	cm. =	12.6	inches, siege mortar (Austrian).
42	cm. =	16.5	inches, siege mortar (Krupp).

It was stated that the 6-inch howitzers have been found especially useful, that intrenched troops pay little attention to shrapnel fire, but that the moral effect of large caliber shell fire is very great, their sound in flight being one of the important factors.

Search-Lights.

Portable search-lights are being extensively used, at least by the Germans, possibly by others, in siege and field operations. Some of the principal forts at Liege were captured in night operations by concentrating search-lights in the faces of the defenders, then advancing in the dark sectors between the beams.

French Howitzers.

Due partly to their enthusiasm over the action of their 2.95-inch field gun, but largely perhaps due to a lack of funds, the French have failed to provide guns or howitzers of large caliber, except a 6-inch howitzer. In order to increase the angle of fall for the 3-inch field gun shell, they have made use of a flat disk called a "plaquette," placed on the head and held in position by screwing home the fuze. An angle of fall is thereby secured somewhat commensurate with that of the outer zone with the 3-inch howitzer. The curves here-

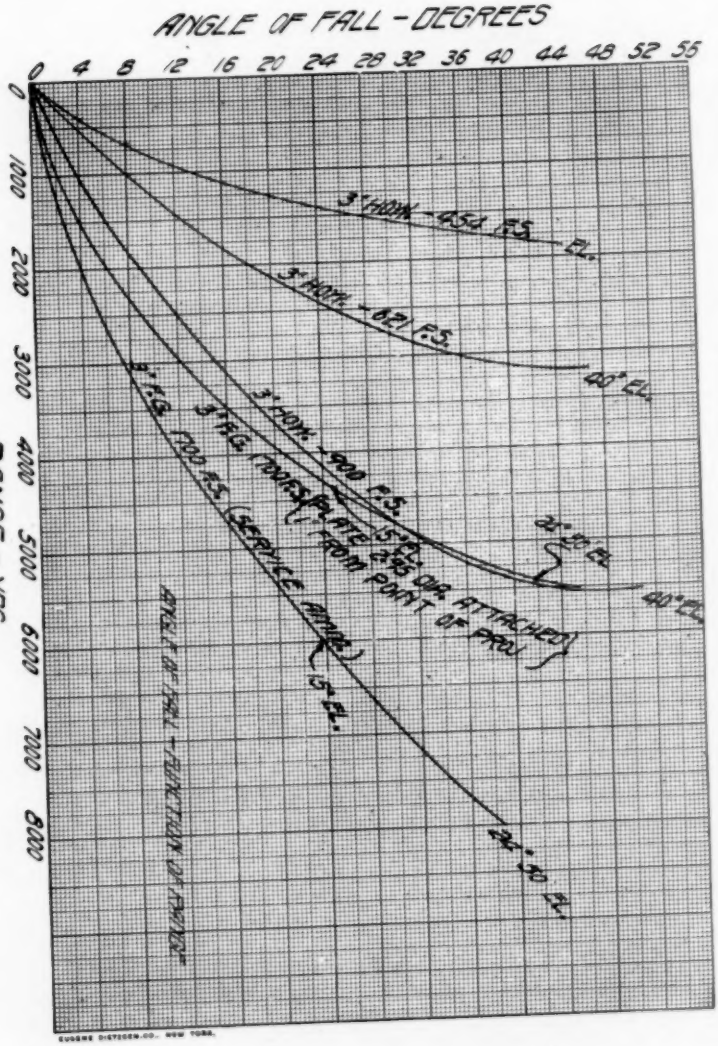

ANGLE OF FALL - DEGREES
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56
RANGE - YDS.
0 1000 2000 3000 4000 5000 6000 7000 8000
3" HOW. - 455 F.S. EL.
3" HOW. - 621 F.S.
3" HOW. - 900 F.S.
3" F.G. (WITH FUSE PLATE AND FAS CAP ATTACHED) FROM POINT OF PROJ.
3" F.G. 1100 F.S. (SERVICE AMMO.)
ANGLE OF FALL - FUNCTION OF RANGE
EUGENE DIETZGEN CO., NEW YORK.

PLATE I.

with show the comparative angles of fall obtained with a similar device attached to the projectile of our 3-inch field gun in comparison with that obtained with howitzer fire. The question of utilizing such a device on shell for the 3-inch and 4.7-inch gun was given consideration by the Ordnance Office and was submitted to the Field Artillery Board for recommendation. It was not deemed worthy of adoption, as the howitzers better accomplish the desired purpose.

German Siege Howitzers.

The Belgian minister of war has made the following statement in reference to the use of heavy siege howitzers by the Germans:

At Namur, the German Artillery employed cannon of 7.5=2.95-inch, 10.5=4.1-inch G. & H. 13 (?), 15=6-inch h., 21=8.3-inch H., and 28=11-inch H. centimeters. It was the enormous 28-centimeter guns that destroyed the defences. The fire was so continuous that it was impossible to attempt to repair the damage done between the forts. The fort of Suarlee, for instance, was bombarded from Sunday morning, the twenty-third of August, and fell on the twenty-fifth at 5 o'clock in the afternoon. Three German batteries of large cannon, using projectiles weighing 350 kilometers=770 pounds shot 600 projectiles on the twenty-third, 1,300 on the twenty-fourth, and about 1,400 on the twenty-fifth against this fort. When the fort fell all the massive central structure was destroyed, and further resistance was hopeless.

The projectile weighing 250 kilos; that is, 770 pounds, is one fired from the Krupp 11-inch howitzer.

The piece weighs about 13,500 pounds and its carriage about 17,000 pounds. It is removed from the firing carriage for transportation and is drawn by a motor truck as shown in ilustration herewith. The traveling gun load is about 19,700 pounds and the traveling load of the carriage about 18,000 pounds. It fires three weights of projectiles varying from about 450 to about 750 pounds. The muzzle velocity varies with the weight of the projectile. The maximum range is probably about 12,000 yards.

British Field Artillery Matériel.

The following table is taken from the British official ordnance manual, 1914, and may, therefore, be considered as accurately giving the types and calibers of guns and howitzers comprised in the

British mobile artillery, together with a statement as to the ammunition supply carried and maintained in the field, per gun:

Description of Gun	With Battery	With Brigade Ammunition Column	With Divisional Ammunition Column	Total with Field Units	With Ammunition Park	Other Reserve to be Maintained on the Lines of Communication	Total to be Maintained in the Field	
								U.S.
13-pr. Q. F	176[1]	220*	.....	396[2]	150	454	1,000	928
18-pr. Q. F	176	76	126	378	150	472	1,000	
4.5-inch Q. F Howitzer	108	48	44	200	80	520	800	
60-pr. B L	80	40†	60	180	70	250	500	
6-inch B. L. Howitzer — 100-lb. shell	50	50	.....	.....	.....	.....	.....	
6-inch B. L. Howitzer — 122-lb. shell	40	40	.....	.....	.....	.....	.....	

* Seventy-six rounds in ammunition wagons, and 144 rounds in G. S. wagons.
† Ammunition column with the battery.
[1] U. S. carries 358 with battery.
[2] U. S. has 464 here.

NOTE.—The capacity, in rounds, of vehicles alloted for gun ammunition is as follows:

	13-pr. Q. F.	18-pr. Q. F.	4.5-inch Q. F. Howitzer	60-pr. B. L.	6-inch 100-lb. Shell	B. L. Howitzer 122-lb. Shell
Gun carriage limber	24	24	12	(a)	.....	.....
Ammunition wagon, with limber	76	76	48	40	.....	.....
G S. wagon	144	108	66	40	25	20
Lorry, 3-ton	280	224	112	112	.....	.....

(a) Two rounds are carried when going into action.

Belgian Forts.

The following data in regard to the Belgian forts have been received and are submitted without opportunity for verification:

The forts surrounding Liege, Namur, and possibly other Belgian cities were constructed between 1888 and 1891, under the direction of General Brialmont. In general the features are a heavy concrete mess from which rise in some forts five, in others six small cupola turrets. The barbettes are sunk about 4.5 feet into the concrete, and the top turns by hand gear. Where the turret meets the barbette a light iron watershed keeps rain from running down between the turret and barbette. This proved to be one of the many fatal weaknesses of these forts.

Where six turrets were installed there were two turrets, each with one 8.2-inch rifled mortar, range 8,000 yards; two each with 6-inch rifles, range 10,000 yards, and two turrets each with two 4.7-

inch rifles, range about 12,000 yards. In no case did the muzzle of the gun project beyond the turret. The highest elevation was about 25 degrees.

In addition to the turrets there was at the highest point of the concrete part a steel tower equipped as an observation tower and provided with a search-light. This tower lowered into the concrete. Some small ventilating shafts came up through the concrete. Below the concrete the turrets opened into a gallery from which led the magazines and the fire control room.

The whole was surrounded by a dry moat, about thirty feet deep and some rapid fire guns were in position in small turrets to cover the ground beyond the moat.

Both Liege and Namur were surrounded by a ring of these forts occupying salient positions from five to eight miles apart. Their garrisons were about 400 men all told, of whom half were artillery and half infantry. At Liege there were few if any troops to hold the lines between the forts. At Namur there were perhaps 200 men along the lines between forts with a few field guns of inferior type and the ground was mined.

The plan of attack was to reduce the two forts with siege artillery, taking them by storm when they were reduced to helplessness, then moving into the city and finishing the other forts by gun fire from the center of the city, after the main body had passed on to continue the campaign elsewhere.

The guns used in the attack on Liege were probably 16.5-inch mortars; length, approximately twenty-four feet; weight of shell, 1,760 pounds; bursting charge, 400 pounds; range used, 8,300 to 15,000 meters, depending on circumstances. They were transported on large tractors. Also 8.5-inch Krupp siege guns and some smaller.

At Namur the largest guns used were the Austrian 12-inch Skoda siege mortars; also German 8.3-inch and smaller. The Austrian siege guns were used in Germany in this campaign, as Russia does not depend on fortified places and there is no employment there for Austrian siege trains. The fatal defects of the forts showed up at once. They were:

(1) Forts and turrets in full view so that spotting and correction of ranges by the attack were easy.

(2) Only one observation position, which, soon buried in débris, was not usable. German forts have four or five inside spotting positions.

(3) No positions belonging to the fort for spotters outside the forts. German forts do all their spotting and observing from concealed positions outside the fort and some distance from it as long as possible.

(4) Turret watersheds torn off by fragments of shell and concrete. The concrete and splinters fell in between turret and barbette and put the mechanism out of order. Many turrets fired not more than two rounds.

(5) Barbetts were not deep enough, the plunging fire striking outside the barbette, went under it and exploded in the base of the turret and in the galleries, killing the crew of the turret, and the fumes rushing through the galleries rendered all in them useless for further work.

(6) In one case (Port Louvain), a shell followed the course of the magazine ventilation trunk and the whole magazine blew up, leaving a crater fifty feet deep and in a confused tangle of overturned turrets, masses of masonry, etc. Practically the entire garrison perished in this fort.

(7) The concrete top in which the turrets are set was not thick enough to withstand the attack of the new 16.5-inch mortars, whose fuzes are timed to explode after the shell has buried itself. In this material these shell would go down over five meters before exploding, thus opening up the galleries and rendering the whole fort untenable.

Gun Positions.

The Germans are said to have begun by not defilading their guns sufficiently far from the covering crests, and consequently lost many guns through their being destroyed or by loss of personnel. The French from the beginning are said to have taken positions far in rear of covering crests, and to have suffered correspondingly less loss. The Germans were said to have ordinarily ranged on the crest covering the French guns and then searched in rear, but seldom far enough to reach the French batteries.

Use of German Artillery.

It has been stated by a French officer that when the Germans were about to attack they massed large quantities of artillery against the position and that at one time at least six regiments of German Artillery appeared to be firing at a single French Division. It is said

that the Germans do not mind losing guns if they can save men by so doing. They apparently believe that the place for artillery is in the front line in an advance and in the rear in a retreat. A prominent British officer has stated:

We have lost more positions and men from the power of the German Artillery, far superior to ours, than in any other way.

Expenditure of Ammunition.

It has been stated on good authority that in the battle of the Marne the French 2.95-inch guns expended on an average 600 rounds per day for at least four and in some cases as many as six days.

Some French reports have stated that the German shrapnel fuzes are irregular in action and very often the bursts are too high. Reports from both French and German sources indicate that common shrapnel are not being found very effective, in view of the general use of intrenched positions. The French are probably finding the extreme range of their 6-inch howitzer—6,500 meters—undesirably short, in view of the fact that the German 6-inch howitzer has an extreme range of 7,500 meters.

It has been stated on good authority that the 2.95-inch guns of the French 6th Army Corps expended in the battle of the Marne, in four or five days, more than 400,000 rounds of ammunition.

Misleading Aero Observers.

A French officer in command of an artillery park has stated that every morning a German aviator came and ascertained his position. They watched for his appearance then changed the position of the park as soon as he had turned back to report the information he had secured. In one case a French battery was located by a German aero and one gun badly disabled by the fire. The battery changed its position, leaving the damaged gun, with several mannikins placed around it. The Germans fired on this disabled gun for six days thereafter. The aeroplane has its limitations of use, especially in foggy weather, under which conditions cavalry is indispensable. A British cavalryman is reported to have expressed the following sentiments as indicating the invariable presence of German guns:

This is no war for Cavalry. Those damned Uhlans won't come out and fight, but every time we get a chance at them they go and hide behind some guns they always seem to have on hand, and we have to sneak off or get a jolly good licking. All one needs now is motor cars, bicycles, and artillery.

Aeroplane Work.

The aeroplane seems to be playing a very important rôle in connection with artillery work. It has been reported that they are in constant use in locating hostile batteries and lines of infantry and in directing the fire of artillery. As a result of their operation the artillery has been forced to provide overhead cover to protect themselves against being visible from aeroplanes. It has been stated that at the beginning of the war the aeroplanes flew at heights of about 2,000 feet, but that several planes were riddled with rifle bullets and that they now fly at a height of about 5,000 feet. In artillery positions held for a time the aviators make a sketch of hostile gun positions, which sketches are transferred to a map. To meet this situation the artillery has found it necessary to provide more gun pits than there were batteries to occupy them. In the morning an observer would fly over an enemy's positions and determine if practicable which emplacements were being used for the day, returning, the battery commanders would be furnished this information. During firings the aviators would signal "overs" and "shorts" chiefly by means of flash pistols with different colored lights. There was also a system in use for signaling errors in deflection. It was stated that the British had been very successful in silencing German batteries by the foregoing method of procedure. It was stated that on reconnaissance work hostile aeroplanes pay little attention to each other as they have more important work to do. An aviator has moreover stated that it is almost impossible to notice another plane until it gets to within about 300 yards if it is flying at a lower level; this on account of the background. The aviators prefer fast planes, not less than seventy-five or eighty miles per hour speed, because of the sense of security which comes from traveling at a high rate of speed.

French Retreat.

The retreat of the French from the north of France towards Paris is said to have been continued night and day and to have been very hard on men and horses. The batteries in some parts of the line made on an average about thirty-eight to forty-four miles per day, a great number of horses being lost from exhaustion. The daily rests were of about two hours duration.

THE NEW GERMAN FIRING REGULATIONS, JANUARY 11, 1914.

By 1st Lieut. Edmund L. Gruber, 5th Field Artillery.

(*Concluded.*)

FIRING, FIRE CONTROL AND DIRECTION IN THE BATTALION.

The duties of the battalion commander in fire control and direction and the technical duties of the battery commander in the firing position are covered in the Firing Regulations, while their tactical duties are described more fully in the Drill Regulations. Since the duties of the battalion commander are primarily tactical, frequent reference is made in the chapter on "Firing in the Battalion" to certain tactical duties discussed in the Drill Regulations. All the duties of the battalion commander in the firing position will, therefore, be summarized in a general way, basing this summary on a study of the Firing Regulations, parts of the Drill Regulations, and information gained from observation and professional books and journals.

The German Firing Regulations in many places state very emphatically that the duties of the battalion commander are almost exclusively tactical, and *that his interference in the conduct of fire in any battery must be an exception and warranted by very unusual conditions. He directs the fire of his batteries but never conducts fire.* When the battalion commander observes that a battery commander has chosen the wrong target or when he with certainty observes errors in adjustment or no effect on the target, he must at once interfere by ordering in a clear and concise manner the necessary corrections to be made. The battalion commander then assumes all responsibility for the firing. For example: The battalion commander from his station observes that a 100-meter bracket, 3,000-3,100 determined by the battery commander is wrong, 3,000 being over. In this case he would order: "Center battery, salvos at 3,000 are over, continue adjustment and determine a new bracket." Or, in fire for effect, he may observe certain ranges ineffective, whereupon he would order: "Left battery, last range was over; bursts are too high." In both cases he assumes responsibility for the changes ordered.

The measures which it is prescribed shall be taken by the battalion commander are more difficult than those prescribed for the battery commander, and cover a wider scope. The battalion commander's most important duty preparatory to firing is that of reconnaissance. His patrols, scouts and reconnaissance officer can only initiate this reconnaissance; the position to be occupied must be reconnoitered and thoroughly examined by the battalion commander himself. Having received his mission and sized up the situation and considered his general line of action, the battalion commander's first step is usually to send back an agent with instructions to cause the battalion to leave the march column and to advance or follow to a certain point, which point must be easy to find and not too near to the probable or proposed position. Under circumstances he may even now also direct the battery commanders to come forward and to report to him, but very often this will not be possible at this time and the battalion commander may be content to leave his battery commanders with their batteries until a general study of the situation and of the position have enabled him to fix a rendezvous.

Having made these preliminary dispositions, the battalion commander rides forward with his staff to make a detailed reconnaissance. After selecting the position for the battalion, he gives his orders affecting the most important things: the location of the battalion commander's station even if only temporary; identification of targets and reconnaissance of the hostile sector; execution of panoramic sketches. These measures the adjutant (lieutenant) at once initiates. The panoramic sketches should show main and auxiliary reference points. The sectors assigned to each battery should show their reference points, target areas and targets, no two being designated by the same phonetic letter; for instance, a, b, f, h, i, l, m, o, r, n, x. The sketch should also show the distance in mils from the main or auxiliary reference points. Copies of this sketch are made, one for the regimental commander and one for each battery commander. These sketches are usually based on the general panoramic sketches of sectors assigned by the regimental commander. Their principal purpose is to locate and identify certain reference points and sectors so as to facilitate the designation and identification of targets, by telephone or courier as quickly as they appear. At the same time the battalion commander should take steps to establish communication with the higher artillery commander or the commanding general.

The battalion commander then gives the following orders:

(a) Battery commanders to report. The place where they are to meet or await the battalion commander is designated. He specifies whether they are to report with their battery details or simply for instructions; whether one battery commander shall report on reconnaissance at some detached point distant from the battalion commander's station. He then decides—

(b) Whether the battery commander's observation wagon shall precede the batteries to the position;

(c) Whether the executive officers of the batteries had better also be ordered forward for instructions;

(d) Whether the time has now arrived when the batteries may be brought farther forward, and in simple situations whether the battalion may be deployed now.

While these orders are being transmitted, the battalion commander, with his communication officer (a lieutenant of the battalion, usually an officer of the reserve), rides over the position, fixes its limits and locates the limits of each battery by means of small flags (different colors for each battery), or by means of markers if they are available or can be spared. During this inspection, he considers the best general location for the different battery commanders' stations and selects the auxiliary reference point for each battery. The favorable location and visibility of these points he will usually have to determine from the battery commanders' stations themselves. If it has not yet been done, he now sends back his communication officer with orders to conduct the batteries to their positions or he may send back the battery agents for this purpose. In both cases he should notify the battery commanders of his action.

The battalion commander then returns to the rendezvous previously designated and there meets his battery commanders. *To them he should give those orders first whose execution will require the most time, and he should anticipate those things which are of immediate or greatest importance to the battery commanders.* Accordingly he must consider and give instructions concerning:

1. The general front of the firing position.

2. Concerning the position itself: the degree of cover and amount of concealment, general location of the battery commanders' observing stations, limits for each battery, and sometimes instructions for the location of the limbers.

3. Communications: location of his observing station or where he will be found; any special arrangements concerning communications.

4. Sectors for observation, target sectors or targets.

When these instructions have been given, the battery commanders can then give the necessary orders to their details and get them started on their duties. This being done, the battalion commander gives further instructions and information as follows:

5. The tactical situation (concerning the enemy, our own troops, especially the infantry) the intentions of the commanding officer.

6. Mission of the battalion and its sector.

7. Occupation of position; each battery installed separately by the battery commanders, or all batteries under the direction of the battalion commander.

8. If necessary the mission of any detached battery whose sector or action the battalion cannot see or supervise.

9. Opening of fire: whether immediately or when ordered, or whether batteries shall report "ready to fire." The order in which the batteries shall fire and sometimes, as in case of targets of narrow front which it may be desired to combat with all the batteries of the battalion, the designation of points for adjustment.

10. Precautions for security, especially by flank batteries. This being completed, the battery commander must himself consider and take the following measures for the battalion as a whole:

(a) Auxiliary observers; their location, and communication with same.

(b) Measures for timely reconnaissance of certain routes to the front and rear.

(c) Disposition of light ammunition column[1] if these have been placed at the disposition of the battalion commander by higher artillery commander.

(d) Communication with the regimental commander, usually

[1]Light ammunition column, one for each field artillery battalion, consists of twenty-four ammunition wagons, containing ninety rounds each or 2,160 rounds. The combined light ammunition columns of a division as a rule march in rear of the infantry. When a combat is in prospect, the artillery commander with permission of the commanding general, gives the order for these columns to leave the march column. He may keep them united or detach them, sending one to each battalion when it is ordered forward. The light ammunition column then follows its battalion, taking position under cover about 600 meters in rear of the firing batteries of the battalion. It therefore corresponds to our combat train.

by an officer as agent; when the battalion is acting alone, communication with the commanding officer of troops.

The measures to be taken by the battery commander in preparation for fire are not near so far-reaching in their tactical importance as are those of the battalion commander. After the battery commander has received his first instructions, his most important orders are:

1. To the scout who keeps the sector or targets under observation; this sector should be given to him as soon as possible so that he may begin his reconnaissance immediately.

2. To the noncommissioned officer in charge of the observation wagon; whether to have the wagon go into position with the battery or to bring it up in advance, which would have to be done when the use of the observation ladder became necessary to determine the elements of fire and to prepare for the occupation of the position. In the majority of cases, the wagon would not be needed immediately since the members of the battery detail habitually take out their equipment and carry it on horse when combat is in prospect.

3. Battery commander observing station: location—whether restricted to a particular place by the battalion commander or whether permitted full liberty in choice of same. He must also decide whether he intends to take advantage of the protection of the observation wagon; in what manner he will use the shield and where the ladder shall be raised. The observation wagon being once placed, it is inadvisable to move it unless absolutely necessary. In doing so valuable time is lost in preparing the new station, telephone and signal stations and connections must be changed in order to assure them proper protection, and all of this will cause a delay in opening fire.

4. Telephone and signal stations: to indicate the location of same at the observing station and at the battery; also the route to be followed in laying the wire; communication with battalion headquarters.

5. Aiming circles: instructions to the noncommissioned officers in charge of each as to location (method of using two aiming circles will be described later). The battalion commander may find it necessary to give to his noncommissioned officer in charge of the instrument the estimated or measured range, the offset for parallel fire and the correction for wind if necessary. He personally directs the instrument upon the target or reference point, then specifies

the aiming point (whether battery commander station, magnetic north, or some prominent point). He also designates the position of the firing battery to No. 2 aiming circle.

6. Scissors telescope and the range finder: place to be designated where they are to be set up, whether on ground, on the observation wagon or on the observation ladder; whether in a tree or under the protection of some other cover; also to determine the minimum range with which the crest can be cleared.

7. The battery commander should then consider well whether all necessary measures have been taken to assure the proper advance to and occupation of the position by the battery, the exact location of the emplacements, etc.

8. He must prescribe the disposition of the limbers and reserve and also be prepared to give his instructions to the first sergeant.

9. Finally the battery commander of any flank battery must not forget to make provision for the protection of his exposed flank.

The battalion commander should, if possible, have his station near that of one of his batteries so that in case any instantaneous targets appear he will be able quickly to direct the fire of a battery upon them. If there is a possibility of not identifying the proper target, he may even use this battery to combat a target in the sector of another battery. Changes of target are usually made at the direction of the battalion commander, but as a rule he avoids changing a task already assigned to a battery. The battery commander is obligated to make a change of target in his sector in case of necessity, or when an opportunity which is likely to pass quickly presents itself, enabling him to produce good effect. But he should report such cases at once to his battalion commander.

It is the duty of the battalion commander to keep himself informed corncerning the stage of the ammunition supply and to see that the batteries are replenished and have on hand a sufficient amount of the required kind of ammunition to complete the task assigned.

Concentration of fire being sometimes impossible, an increase in the rate of fire of a particular battery well provided with ammunition will more often prove practicable than the concentration of the fire of a number of batteries.

The battalion commander is guided in choice of targets by the principle, *that the sole object of the field artillery must be to give*

the infantry the most effective support. He should therefore combat those targets which at the time are most dangerous to the infantry. The tactical situation will therefore determine whether this support can best be given either by firing upon the hostile infantry or by destroying or at least neutralizing the hostile artillery and preventing it from developing its full fire effect.

A battery detail consists of:

One lieutenant, reconnaissance officer and assistant to the battery commander.

One noncommissioned officer, musician and agent, usually carries battery commander's observing telescope.

Two noncommissioned officers, each with an aiming circle.

Three agents and scouts—one as agent to battalion commander, and the other two with the battery as battery scouts. One of these carries the range finder.

One noncommissioned officer and one private, mounted telephone and signal detail; each equipped with a telephone, ground, two spools of wire with hand reel and connectors, pole climbers' kit, etc.

One observation wagon, the limber of which carriers 36 rounds of ammunition; the wagon has a receptacle for all instruments and a housing for a detachable shield and the observation ladder which can be erected either on the wagon or on the ground.

Three drivers for the observation wagon.

Five cannoneers mounted on the observation wagon. Nos. 4 and 5 act as telephone operator and signaller at the battery station; Nos. 1, 2 and 3 man the wagon, erect the ladder, intrench the battery commander station, act as line guards, relay messages, are used as horse holders, etc.

Each battery and battalion has three telephones, buzzer type.

The battalion headquarters has a similar wagon and signal detail. Also three noncommissioned officers to operate telescope, range finder and as orderlies. The number of scouts is not prescribed.

FIRING INSTRUCTION.

Part II of the Firing Regulations takes up the Firing Instruction of the Personnel. The object of this instruction is to train all officers to master the fire of their batteries so as to be able to direct and to control this fire with certainty and skill. They must consider themselves as instructors and the battery as a school. As many

noncommissioned officers as possible must be trained to act as chiefs of platoon, to conduct the fire of a section or platoon independently, and when conditions permit also conduct the fire of a battery. All officers, both active and reserve, ensigns *(Fähnriche* and *Fahnenjunker)*,[2] one year volunteers,[3] noncommissioned officers and non-

[2]In time of peace officers are recruited from two classes of young men: (1) from the Corps of Cadets (twelve institutions), who when graduated at seventeen, join the army as sword-knot ensigns *(Portépéefähnriche)*; (2) from young men of education, culture and good social standing (possessing "nobility of the mind," as the Germans put it), who join the army as color privates *(Fahnenjunker)*. The acceptance of a young man as a *Fahnenjunker* is decided after a careful inquiry into his standing, antecedents and general qualifications by the commanding officer of the regiment for which the young man has applied, being usually the regiment in or near his home town. In Germany, the regimental commander is held responsible by the sovereign for the efficiency, standing and deportment of his officers. His unfavorable recommendation will prevent a young man from entering upon a career as an officer. The *Fahnenjunker* begins his military career as a private, wears that uniform, lives in barracks for the first month and during that time has an old noncommissioned officer detailed over him as instructor and monitor. He is then promoted to *Gefreite* (lance corporal) and later to noncommissioned officer. After five or six months' service he undergoes an examination for appointment as sword-knot ensign *(Portépéefähnrich)*. This appointment is by the sovereign and is conditional upon—(a) educational qualification, which must be demonstrated to a board either by an examination or by producing a diploma *(Abiturientenzeugniss)* from a *Gymnasium* or *Ober-Realschule* (both corresponding to our high school); (b) the recommendation of his battery, battalion and regimental commanders certifying to the candidate's mental, moral and physical qualifications, as well as to his professional zeal and efficiency.

The cadets mentioned in Note 2 and the *Fahnenjunker* mentioned in Note 3, having received their appointment as *Portépéefähnriche*, are immediately sent to a war school *(Kriegsschule)*, of which there are twelve in the Empire. Here they are thrown together and undergo the same military training and education. The course covers a period of about nine months and during this time the rank of sword-ensign *(Degenfähnrich)* is acquired. The officer's examination is taken at the completion of this course, whereupon the *Fähnrich* joins his regiment. He is then practically a conditional second lieutenant, joins the casino (mess), has all the privileges of a commissioned officer and fraternizes with them all. His brother officers now have an opportunity to judge whether the ensign has improved his opportunities and is fit to become their comrade. In a month or two the regimental commander is notified that the ensign has passed his officer's examination and is asked whether there is any objection to his receiving a commission as a second lieutenant in the regiment. If the ensign receives a favorable recommendation as to his professional ability by his immediate commanders and is elected by the majority of the officers of the regiment, his commission immediately follows.

[3]These are young men between the ages of seventeen and twenty who have passed an examination showing certain educational, scientific, technical or professional qualifications, and have the means of buying their own uniforms and of equipping and subsisting themselves. In return they are permitted to absolve their military obligation in one year, when they are furloughed to the reserve. It is from this class of men that the great majority of reserve

commissioned officer aspirants, must thoroughly understand the mechanism, function and use of all parts of the matériel. Musicians (noncommissioned officers) must be trained in the operation of the battery commander observing telescope and in semaphore. Special instruction must be held for officers, noncommissioned officers and selected personnel, in patrolling, scouting, observing and in reconnoitering targets, and the like. It is desirable that every officer, noncommissioned officer and all members of the battery detail should know and be able to use the Continental (Morse) Code.

Great stress is placed upon developing and training the vision of cannoneers. All recruits are not trained as cannoneers. Good eyes, intelligence and previous occupation usually determine whether a man shall be trained as a cannoneer or a driver. For each section there is one cannoneer on the caisson who is trained in the duties of a driver. All recruits are given a thorough instruction in equitation, usually under one of the senior lieutenants who also has charge of the training of remounts, which training practically covers a period of one and one-half years before these horses are required to do straight battery duty. All drivers are trained in the duties of cannoneers assigned to the caissons, and in such movements in the school of gun squad requiring man-handling. For the drivers, more time is devoted to instruction in equitation, harnessing, grooming and care of harness, horses and horse equipment, and especially in driving, but instruction in driving is not taken up until these recruit drivers have had a thorough instruction in equitation. On the other hand the instruction of the cannoneers is pushed to a very high stage of efficiency so that the greatest possible number of expert gunners may always be available.

The cannoneers' and gunners' instruction in each battery is in charge of an officer, usually one of the junior lieutenants of the battery. His work and schedule are supervised by the battery commander. He is assisted by two noncommissioned officers and all the old gunners. He is held strictly responsible for the results obtained and his efficiency is judged by his success. A system which requires an officer to "produce the goods" in order to "hold his job," naturally needs no so-called "examinations for promotion" to determine

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and *Landwehr* officers are drawn. For qualification as such they are required to serve with the colors for about one month each year for three years after being furloughed. It is also from this class of men that the noncommissioned officers and the members of the battery detail are chosen.

his efficiency or his ability to higher command. During the annual period for individual instruction each lieutenant is placed in charge of a department. He will hold this department for probably two or more years. In the meantime, he will observe and be coached in the duties of the next higher department, occasionally act as substitute instructor. He will thus get the full benefit of his predecessor's riper experience, gain confidence and be prepared to step in at any time to take charge. When a lieutenant reaches his captaincy and takes command of a battery, he will have had experience in all the departments of individual instruction as an instructor, in each department he will have broken in junior officers. His right to promotion and his ability to higher command will be determined by his uniform success in all of these duties.

The firing instruction is divided into two periods—(a) cannoneers' instruction; (b) special gunners' instruction.

CANNONEERS' INSTRUCTION.

This cannoneers' instruction begins about the middle of October, a short time after the recruits have been mustered in. It continues until the end of January, at which time a general inspection of the recruits' training is made by the battalion commander in the presence of the regimental and higher commanders. This inspection covers every phase of the recruits' instruction and extends over a period of a week or ten days for the whole battalion. Its purpose is to give the battalion commander a full opportunity to judge whether the individual training of the recruits has been uniform and has attained a proper standard preparatory to taking up the battery training. The battery commanders are given the greatest freedom consistent with regulations and permitted to show their individuality as long as the desired results are obtained. This recruit inspection embraces calisthenics, gymnastics, marching, dismounted drill, cannoneers' instruction, school of the gun squad, equitation, visual training, personal hygiene, care and repair of clothing and equipments, customs, etc

The Firing Regulations prescribe the different exercises in this cannoneers' instruction. They are:

(a) Visual training, principally without use of optical instruments. The recruit is taught to find and identify objects and then to describe them in a clear and concise manner. The instructor

causes the men to seek, locate and to describe different objects in a designated sector. He acquaints them with characteristics of the terrain, topographical features and how to describe them; changes in appearance of topographical features and objects as seen from different points of view and at different ranges. In the visual reconnaissance of a sector, a time limit is later fixed, errors are immediately pointed out and discussed; also the effect of background, light, atmospheric conditions and of distance. The recruits must also learn to keep moving objects, persons and target under constant observation, to be able to judge and to report changes in direction, movement or condition, and also to be able to estimate where they will reappear after a temporary disappearance. At first simple objects and general features of the terrain are used, later on objects and targets approximating service conditions are substituted. The men must be taught to draw proper conclusions from indications of dust, smoke and light as affecting the appearance, size and extent, and the direction of movement of objects and targets. Gun flashes must be identified and located; for this exercise mirrors, polished metal plates or white disks are used to represent gun flashes. This training then leads to the estimation of ranges. The recruits are taught that the estimation of a range or a distance is not a matter of guessing but an accomplishment that is acquired through applying a definite method and by constant practice. The use of the field glass is then taught, at which time each man is given and must memorize his interpupillary distance and setting for each eye-piece.

(b) Laying—

1. For deflection—a white target with a median black vertical stripe is used. The instructor first lays for deflection himself, has the recruit look through the sight and note the correct way to lay. He then changes the setting, throws out the level and has the recruit himself lay for deflection. This the instructor then inspects, making the necessary correction of errors.

2. For elevation—a target whose upper half is black and lower half white (to teach the recruit to lay on the bottom of the target) is used. The instructor proceeds in a manner similar to the method described above in laying for deflection.

3. For deflection and elevation—the target is white with a black triangle standing on one angle, Fig. 8. The field of the German sights and of the aiming circle, shows a verticle line for deflection

and two oblique lines coming to a point at the center of the field, Fig. 8. At first no settings are required with the instruction in laying. The instruction in setting the sights is carried on separately. As soon as possible, the setting and laying are combined. The instructor now increases the difficulties and introduces variety by changing targets, occasionally selecting natural objects, giving ranges and deflections in commands and for the howitzer by passing to zone fire. The recruits are then taught to make changes in deflection by additions and subtractions or by setting off the proper deflection difference corresponding to their gun. In this connection, the men are taught to use the scales—for instance, the deflection scale on the limb and the micrometer—as a calculator, and not to attempt problems in mental arithmetic.

FIG. 9

The instructor always shows the amount of error graphically, correcting the laying by moving the sight shank or the deflection scale. He also explains the reasons for deviations in deflection due to light, wind, sight not leveled, failure of the spade to engage, and how these may be corrected by appropriate deflection corrections, leveling the sight or digging under a wheel, or by securing the spade by digging or by removing the snow, dirt, etc. They are also shown why it is necessary to dig down the spade or the wheels when the desired elevation, or depression, as the case may be, cannot be obtained. After the first few days, the instruction takes place in the open and as soon as possible, service targets and natural objects are used.

Practice is then had against moving targets, first using targets moving in the direction of fire, then perpendicular and finally oblique to this line. The recruits are required to hold on and to follow the movements of the targets until the moment of firing and

not to lay ahead. The instructor causes the targets to halt, disappear, reappear, change direction, etc., at each change in position or movement of the target requiring the men to call out: "The target has halted, has disappeared, has reappeared, is retreating, or is obliquing to the right," etc. In order to determine whether the men are laying right on the target, the instructor causes the target to be halted, giving the signal when the man calls "ready."

In addition to the six guns, each battery has for recruit instruction purposes several laying apparatus. This laying apparatus is mounted on a tripod which is roughly leveled. All direct and indirect laying for deflection can be practiced with this apparatus. The clinometer elevation cannot be obtained. The apparatus as issued is made of steel, but many batteries improvise them of wood.

The setting and the laying for range with the clinometer are then shown. The movement of the bubble corresponding to an elevation of depression of the gun is practiced so that each man upon seeing the position of the bubble will quickly and mechanically elevate or depress as may be necessary. The relation between laying for range with the clinometer and with the sight shank is then explained; also that when targets are above or below the level of the gun, the sight shank and the clinometer elevation do not agree, but must be corrected by an amount equal to the angle of site. The measurement of the angle of site with the gun is shown and practiced, and each man is taught the use of the emergency sight and on what occasions to use it. The setting of the fuse setter and of the fuse are then taken up.

By the end of January a satisfactory proficiency must be attained in this instruction. *This preliminary cannoneers' instruction, in contradistinction to drill of the gun squad, is the most important part of the recruit cannoneers' instruction. Every duty that he performs, every part of the matériel that he handles, its action, function and relation to the other parts and the work he is performing are carefully explained to him.* This is then the time of the recruit inspection made by the battalion commander. After this inspection the ten best recruit cannoneers are selected for special gunners' instruction. This class is augmented by the one-year volunteers, of whom there are on an average of six per battery, and by the young ensigns *(Fahnenjunker)*, if there are any in the battery. They receive their gunners' insignia at the battery inspection made by the bat-

talion and regimental commanders in April. Regulations forbid their detachment from the battery in which they have gained their classification.

The rest of the recruit cannoneers are continued in their instruction, especially now in work in the gun squad. Gradually these recruits are absorbed in the battery and by the time the battery inspection is made in April, they should be able to fill according to their ability all of the cannoneers' positions and if necessary also that of gunner.

SPECIAL GUNNERS' INSTRUCTION.

After January, the requirements in the special gunners' class are increased. Difficult and indistinct targets and objects are selected. The greatest speed consistent with accuracy is sought. Great care is taken to obtain uniformity in laying by all the gunners and for this purpose numerous prize contests are held at frequent intervals. The instruction of the old gunners is again taken up when the recruit cannoneers are taken up for instruction in the battery. The visual exercises described under cannoneers' instruction are continued throughout the year.

Direct and indirect laying and fire are carefully explained, and the occasions when and reasons why each should be used. The use of the angle of site on the clinometer to regulate the height of burst when the setting will be beyond the limits of the regulator (corrector) scale is explained. Likewise that in firing on aircraft, the regulator corrections are made by tilting the head of the panoramic sight.

In addition, the class is taught the use of aiming points, section control or laying points, different methods of establishing the directing gun, how to establish parallelism, reciprocal laying, the principles involved in shifting, or in opening or closing the sheaf of fire: also how to measure the deflection and the angle of site with the gun.

Proficiency as gunner is recorded on the discharge papers and entitles the holder to wear the gunner's insignia whenever again called to the colors. As an incentive to the gunners, two prize gunners' competitions must be held each year. They are known as the First and the Second Gunner's Competitions. In the First Gunners' Competition only the recruit gunners' class and the one-year volunteers participate.

THE FIRST GUNNER'S COMPETITION.

This competition is a contest for accuracy in laying and setting of sights and takes place in each battery in March, marking the completion of the recruit gunners' instruction. There are three tests with a total of eight trials, all elementary and designed to show the candidate's accuracy and speed in setting and laying. Test (a), two trials for range and deflection with the prismatic or open sight (direct laying, corresponding to our peep sight laying). Test (b), two trials in setting off the deflection and regulator (corrector) on the panoramic sight. Test (c), four trials laying with the panoramic sight.

To insure like conditions for all the candidates in any one battery, a sufficient number of guns is borrowed from the other batteries to give one gun for each candidate. This will usually place about eighteen guns in line with an interval of five meters between guns.

For test (a), the targets are rectangular 1.7 meters high and one meter wide, upper half painted black, lower half white. The background must be different for each trial, the distance between 400 and 500 meters. The commands and the test are practically the same as for our direct laying with the peep sight. The gun is first given a general direction so as to bring the targets within the limits of the traverse of the gun. All candidates lay at the command "Target ——, Range——." After having laid the gun they call out "Ready," the number of their gun and then step clear. The order in which the candidates finish is recorded and all sights and laying are then examined. Laying is correct if the point is on the bottom of the black portion of the target and is not off the target in deflection. A penalty of ten points in each case is scored if the laying is incorrect, or if the range setting is inaccurate or wrong.

Test (b), for accuracy in setting deflection, regulator and range. The officer conducting the test first commands a deflection and regulator as, "Deflection ——, Regulator, ——," whereupon the candidate makes his settings. Now at intervals of twenty seconds, the commands are given for four different changes in deflection and regulator, as, "Add 80, Down 5;" then in twenty seconds, "Subtract 30, Up 3," etc. Twenty seconds after ordering the last change, the command "Mark" is given, whereupon each candidate records his final settings on the shield in chalk or pencil and steps clear. A penalty of ten points is scored in each case if the final deflection or

the regulator setting is incorrect, or if a mistake is made in recording these readings upon the shield.

Test (c), with the panoramic sight. Small objects which are difficult to see and which are not under 3,500 meters distant are used. The first trial is direct laying with the panoramic sight. The command is "To our front, a tripod on round knob, Range ——." The second trial—the gun being laid upon the above object or target, the command is, "Aiming point the church tower to the right. Measure the deflection." Having measured the deflection, the candidate at once records it upon the shield.

The third and fourth trials—indirect laying with the panoramic sight; for howitzer batteries one of these trials should require a change to zone fire. The commands are, "Deflection ——, Range ——, Clinometer Angle of Sight ——." The gunner calls out the number of his gun when he has laid his gun for deflection and range, and has then turned his sight upon his auxiliary control or aiming point. The officer conducting the tests then inspects the laying upon the auxiliary aiming point and all settings of the sight; measures the errors in range and deflection in mils. In addition a penalty of ten points is scored in each case if the readings are incorrectly recorded, if the clinometer level is not centered, or if the settings are inaccurate.

The following type record will give a better idea of the contest and the method of scoring. The scores of the three best candidates are given in Table "A."

THE SECOND GUNNERS' COMPETITION.

This contest is for the six best gunners of the battery and takes place immediately after the return of the battery from the annual battle firing practice. It consists of four tests with a total of eight trials.

Test (a), two trials, same as test (b) first gunners' competition.

Test (b), two trials, laying on gun flashes.

Test (c), two trials, same as test (c) first gunners' competition, without the requirement for recording.

Test (d), two trials, indirect laying using aiming circle as aiming point and then selecting section control or aiming point.

Tests (a) and (c) are similar to tests (b) and (c) in the first gunners' competition.

"A"—FIRST GUNNER'S COMPETITION.

Name of Candidate.	(a) Laying with the prismatic—open sight.					(b) Changes in deflection and regulator.					(c) Laying with the panoramic sight.								Totals.		Remarks.
			Result.				Errors.						Errors.								
	No. of trial.	Order to finish.	For laying.	For setting.	Total.	No. of trial.	In deflection.	In range.	In recording on the shield.	Total.	No. of trial.	Order to finish.	In elevation.	In deflection.	In recording on the shield.	In clinometer.	General accuracy in setting.	Total.	Points.	Prize.	
Priv. C.	1	5	.....	.....	21	1	10	.....	.....	10	1	8	1½	.....	.....	.....	.....	30½	61½	II	
	2	6	10	.....		2	.....	.....	.....		2	5	.....	.....	.....	10	.....				
	.....	.....	.....	.....		.....	.....	.....	.....		3	7	.....	.....	.....	.....	.....				
		11	10				10				4	29	1½			10					
Priv. D.	1	6	10	.....	44	1	.....	.....	.....	10	1	9	3	.....	.....	.....	.....	27	81	III	
	2	8	10	10		2	10	.....	.....		2	2	.....	.....	.....	.....	.....				
											3	7	.....	2	.....	.....	.....				
		14	20	10			10				4	22	3	2							
Priv. E.	1	9	.....	10	26	1	.....	.....	.....	.....	1	2	.....	.....	.....	.....	.....	19	45	I	
	2	7	.....	.....		2	.....	.....	.....		2	4	.....	.....	.....	.....	.....				
											3	1	.....	2	.....	.....	.....				
		16		10						.....	4	10									
												17	.....	2							

Test (b), two trials. The targets are two guns placed in position at about 3,000 meters, being defiladed so that the flashes and smoke are just visible when fired. Maneuver flash cartridges are used. The general direction of the target having been indicated and the candidate having given his gun this general direction, the command is, "With time shell, to the right front, gun visible by its flashes, Up 1, Range ——, Clinometer (angle of site) ——." The candidate sets off the data, rises from his seat, takes up his field glasses and looks in the indicated direction. The officer then gives the signal to cause the flash to be fired and calls out, "Lay." Each gunner spots the flash and smoke, and lays for deflection and range, calling out the number of his gun and stepping clear when he has done so. When all have completed, the instructor causes a white screen to be held at the muzzle of the target gun, inspects the laying, scoring the errors in a manner similar to test (c), first gunners' competition.

Test (d), two trials, using aiming circle or the battery commander station as an aiming point. For one trial the aiming point is in front and in the second in rear of the battery. For the howitzer, the commands for zone fire are given in one trial. The commands are, "Direction of fire—indicated;" then "Time shrapnel, aiming point, aiming circle No. 2, Down 1, Range ——, Clinometer (angle of site) ——" Each candidate causes his gun to be given the proper general direction, then sets off the data given in the command; this done, he obtains from the non-commissioned officer at the aiming circle (which is usually near the battery) the proper deflection for his gun and takes post in rear of the gunner's seat. At the command, "Lay," the laying is completed and each gunner then selects his own auxiliary aiming point. The errors in deflection and range are afterward measured and penalties scored as before.

The following type record will give a better idea of the contest and method of scoring as noted in Table "B."

In the German Army as in every department of their political institutions, it is a principle to separate the honors from the office. In this way, they always hold out an incentive for greater efficiency and better service to every man no matter what his rank may be. For this purpose, badges of distinction or honor, in ten grades or degrees have been created for such non-commissioned officers (including one-year volunteers) who in any capacity and such selected

"B"—SECOND GUNNERS COMPETITION.

Name of Candidate.	No. of trial.	(a) Changes in deflection and regulator.				(b) Laying on gun flashes.					(c) Laying with panoramic sight.					(d) Indirect lying AP—Aiming circle.					Totals.	
		Errors.					Errors.					Errors.					Errors.						
		In deflection.	In regulator.	In recording.	Total.	Order to finish.	In deflection.	In clinometer.	Accuracy in setting.	Total.	Oder to finish.	In deflection.	In clinometer.	Accuracy in setting.	Total.	Order to finish.	In deflection.	In clinometer.	Accuracy in setting.	Total.	Totals.	Prize.
Priv. B.	1	10	10	.....	40	3	1½	10	10	39	4	1½	10	10	28½	5	5½	.....	.....	16½	124	III
	2	10	.....	10		3	1½	.....	10		3	.....	.....	.....		6	.....	.....	.....			
		20	10	10		6	3	10	20		7	1½	10	10		11	5½					
Priv. D.	1	.....	.....	10	20	2	.....	.....	.....	17	6	1	10	10	53½	1	1½	10	10	34½	115	II
	2	.....	10	.....		5	.....	10	.....		5	1½	10	10		2	.....	10	.....			
			10	10		7		10			11	2½	20	20		3	1½	20	10			
Corp. X.	1	.....	10	.....	10	6	.....	10	10	27	1	2	.....	10	20½	3	1	.....	10	15	72½	I
	2	.....	.....	.....		1	.....	.....	.....		6	1½	.....	.....		1	.....	.....	.....			
			10			7		10	10		7	3½		10		4	1		10			

privates *(Gemeinen)* who as gunners have distinguished themselves by exceptionally efficient service during the annual period of firing practice. A next higher grade may be earned each year. When the badge for the next higher grade is earned, the holder takes off the badge of the lower grade. These honor badges are awarded by the regimental commander and are the occasion of a very impressive ceremony. They are apportioned at the rate of not more than six per battery; three are reserved for the non-commissioned officer cadre (permanent personnel) and three for the selcted privates who are serving one or two years with the colors. In addition, similar badges may be awarded to one-year volunteers who are aspirants for commissions as reserve officers.

A study of the above tests is very interesting. The tests show a great variety, are all very practical, involve the most important operations in the duties of a gunner in the firing battery and are bound to arouse a keen interest in the men. It must be remembered that the aiming and pointing device on the German gun is similar to that on our howitzers, where the gunner at all times lays for deflection and range. In addition the German gunner must also make all changes for the height of burst on the regulator (corresponding to our corrector). The creation of additional honors as an incentive to *continued* efforts and efficiency as gunners or in some other capacity in the firing battery, is also a splendid idea. There are many officers who believe that a great mistake was made in abolishing the old first-class gunners badge, and many enlisted men have stated that the real incentive to them was the gunner's badge and not the pay; that if they had a choice between the badge and the pay, they much preferred to wear the badge. That many did wear this badge with great pride is known to all. But why the field artilleryman should be deprived of his little distinction while the infantryman and the cavalryman retain their badges in marksmanship is not quite so clear.

Our gunners' order should be revised so as to enable us to classify our cannoneers and gunners by more practical tests. The present gunners' order is, however, much more practical than the old one in force about 1907 which, among other things, determined the classification of a gunner by his proficiency in obtaining a good center of impact on a bull's-eye target with .30 subcaliber ammunition. We should be able to classify our men as second-class, first-class and

expert gunners just as the Infantry and Cavalry classify marksmen, sharpshooters and expert riflemen. If an Infantry expert rifleman is worth $5 per month extra, surely an expert gunner, whose knowledge of and proficiency in everything that pertains to the gun should be measured by the highest requirements, is worth at least the same amount. It is just as easy to maintain that he would be worth more, for an expert gunner can more easily impose his personality and impress his knowledge and efficiency on a gun squad than an expert rifleman can on a squad or section. It is also unfair to those Field Artillerymen who have ability, to leave them nothing higher than a first-class gunner classification for which to aspire, and to place them under such a disadvantage in pay as compared with the other branches of the service. For this reason alone it is hoped that a revision of the gunner's order permitting a classification as second-class, first-class and expert gunner will be made. Prerequisite to qualification in any one class should be qualification in the next lower class. Qualification should be good for a whole enlistment, with the privilege of trying for the next higher qualification in the next year. Additional distinction without increase of pay should also be provided for such limited number of expert gunners as have in the opinion of their commanding officers shown marked ability and rendered exceptional service during a particular firing practice season. A man, no matter how much service he has had, should always have some distinction in gunnery for which to work.

USE OF THE AIMING CIRCLE AND THE BATTERY COMMANDER'S TELESCOPE.

In each battery there are two aiming circles operated by two non-commissioned officers called R_1 and R_2. The aiming circle is a small angle measuring instrument made of brass or some other non-magnetic material. It is very compact, provided with a 4-power telescope of wide field and a means of measuring horizontal and vertical angles just as with our battery commander's telescope. It is also provided with a magnetic needle, mounted as in a transit. This permits the guns to be laid for direction when no aiming point is available and the battery commander's station is at a distance or cannot be seen from the guns. The aiming circle is mounted on a tripod or on a small metal table carried in each case. With each

instrument is a deflection correction card for offsets as shown below. The graduations on the limb are in mils and made clockwise, each semi-circumference being numbered from 0 to 3,200, 1,600 being parallel to the line of fire. The graduations on the deflection scales of the panoramic sight and the scissors observing telescope are exactly the same as the aiming circle.

"C"—DEFLECTION CORRECTION TABLE.

Offset when the BC station* is to be
Left | Right
Add | Subtract
of the Firing Battery

RANGE in meters	Offset in mils when the distance from the line of fire in paces is													
	20	40	60	80	100	120	140	160	180	200	300	400	500	Correction for wind if from the Left — Right then Add — Subtract
1,000	16	33	49	65	82	98	114	131	147	164	247	332	419	
1,200	14	28	41	54	68	82	95	109	123	137	206	276	346	
1,400	12	24	35	46	58	70	82	93	105	117	176	236	295	
1,600	10	20	30	40	51	61	71	81	92	102	153	204	256	
1,800	9	18	27	36	45	54	63	72	81	91	136	181	227	
2,000	8	16	24	33	41	49	57	65	73	82	123	164	205	
etc.		etc.					etc.					etc.		
to			to					to					to	
6,000	3	6	8	11	14	16	19	22	24	27	41	54	68	

* Does not apply to our BC telescope when AP is in front.

Lieutenent General Rohne in a recent article has criticised this deflection correction table, saying that it is not simple enough, contains too many figures (350 in number) that are not easy to find, and introduces a factor of accuracy into a problem where all the other factors are based upon estimation. For instance, in determining the deflection for the right gun by the parallel method using the battery commander's telescope as the aiming point, we estimate the range to the target and the distance to the right gun: Example: (Fig. 9) T is the target, G the right gun, B is the battery commander's telescope, and BA the perpendicular distance from the line of fire equal to 100 paces or 80 meters. The offset on the target is the angle T B T^1, which is equal to G T B. Representing the value of this angle by "x," its value can be determined from the equation:

$$x : 1{,}000 :: B\,A : A\,T \text{ (practically the range)},$$

from which we have:

$$x = \frac{1{,}000\ B\ A}{R} = \frac{80}{4} = 20$$

which would be the offset in mils on T toward T^1. But assuming a probable error of 10 per cent. in estimating R and the dis-

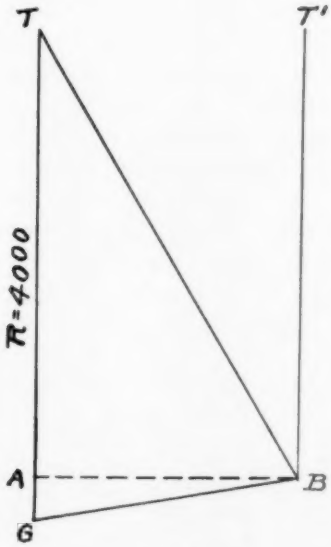

FIG. 9

tance to the right gun, there is in this case a resulting probable error of 14 per cent. in the offset. If some other point were used as the aiming point, the error might even be more. He, therefore, recommends a simpler offset table in which only round numbers are taken. This is given below in yards, with a few variations as applied to our gun and units of measure.

"D"—TABLE OF OFFSETS IN MILS.

Distance of BC station from the Line of fire of the right gun in yards. / Range of T or Distance to AP in yards.	50	100	150	200	300	400	500
1,000	50	100	150	200	300	400	500
1,500	35	65	100	135	200	265	330
2,000	25	*50	75	100	150	200	250
2,500	20	*40	60	80	120	160	200
3,000	15	*35	50	65	100	135	165
3,500	15	*30	45	60	85	115	145
4,000	15	*25	40	50	75	100	125
4,500	10	20	35	45	70	90	115
5,000	10	*20	30	40	60	80	100
5,500	10	20	30	35	55	75	90
6,000	10	15	25	35	50	65	85
8,000	5	10	20	25	40	50	65
10,000	5	*10	15	20	30	40	50

But to many of us it must seem imperative that the use of any table or the necessity of any computation should be avoided in the field. This table, simple as it is, is valuable only as an aid to memory. An inspection will show that the principal values to be remembered are those marked (*), being the offsets for 100 yards, for the principal battle ranges and for the distance 10,000 a distance which occurs quite frequently for an aiming point. For distances greater than 10,000, the error in the offset will ordinarily be so small that it can be disregarded unless the battery commander is at a considerable distance from the guns. Knowing the offset for 100 yards, the others can be easily calculated mentally by merely taking one-half for an offset which is around 50 yards, and by doubling, trebling, etc., the offset for 100 yards for any other distance from the battery commander's station as 200, 300 yards, etc. The present war will no doubt show that this distance will more often be over than under 200 yards.

It is, of course, very desirable that the first shot be as close as possible in deflection to the point chosen for adjustment, but time is so important an element that unnecessary refinements become very objectionable, and the first shot may be considered satisfactory for deflection if it is within the front of the target, enabling the battery commander to make his corrections with rapidity and ease. When time is available, any desired degree of refinement and accuracy may be attempted.

The aiming circle is used to determine the deflection for the battery; to measure the angle of site; to measure deflection changes and offsets; and to determine the minimum range to clear the crest.[4] The battery commander's observing telescope can also be used for the same purpose, but it is intended for use by the battalion commander and battery commander for observation only, leaving R_1 free to use the aiming circle at all times for checking up or for measuring changes in deflection for any targets in the assigned sector.

Before the recent adoption of the present panoramic sight, the Germans developed a method of directing the guns of a battery involving the use of two aiming circles. Its advantage is that practically any position may be occupied without regard for the aiming point. At that time, it also circumvented the necessity of installing

[4]Pp. 486 and 487, FIELD ARTILLERY JOURNAL, October-December, 1914.

a panoramic sight, something which they were particularly anxious to postpone for economic reasons until the sight had been perfected and made more serviceable. This method is now used only when a suitable aiming point is not available, when the distance from the battery commander's station to the battery is great, or when neither the battery commander's station nor a suitable aiming point are visible from the guns.

It may be interesting to describe how this method can be applied to our present battery commander's telescope, because occasions may

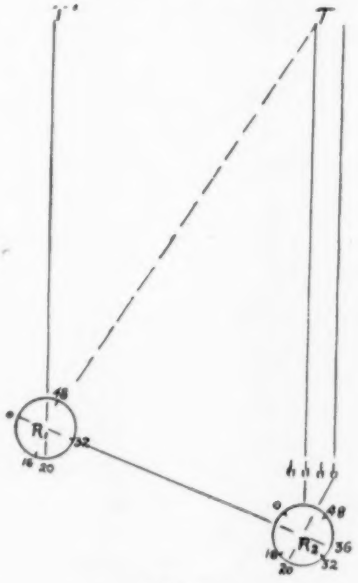

FIG. 10

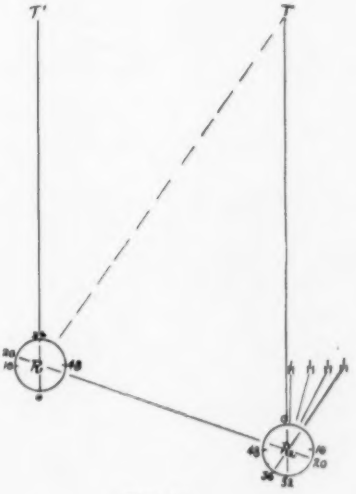

FIG. 11

arise when it can be used, especially in howitzer or heavy batteries. Since our present battery commander's telescope is graduated counter clockwise, the method can be applied only for the directing gun or for each gun separately, and is, therefore, not simple. In Fig. 10, R_1 is the position of the telescope at the battery commander's station; R_2 the position of the second telescope a little in rear of the firing battery. R_1 sets at zero and lays on R_2 with the slow motion screw; he then releases and swings on to the target T, after which he takes his offset away from the guns to T^1. This reading is then sent to R_2, who sets it off and lays on the directing

gun with this reading, using the slow motion screw. R_2 then releases and swings around to R_1. The resulting reading is the deflection for the directing gun using R_2 as an aiming point. This method cannot be called exactly simple, which is all due to the fact that our telescope is graduated counter clockwise. The German instruments, as before mentioned, are all graduated clockwise, from 0 to 3,200 in each semi-circumference. The method is also very easy for an instrument graduated clockwise from 1 to 6,400 (Fig. 11).

R_1 sets his instrument at 0, estimates his offset and lays it off away from the guns to T^1, using the slow motion screw. He then releases and swings on R_2, and sends the reading to R_2, who sets this off on his instrument and lays on R_1 with this reading, using the slow motion screw. R_2 then releases and beginning at either end, lays on the sight of each gun in turn and calls off the deflection. Each gunner then sets off this deflection on his sight, lays on R_2 as an aiming point, then selects his own auxiliary aiming point or control point which should be near the line of fire and at least 20 meters in front or in rear of the gun.

The clockwise graduation has many advantages. To measure any deflection, zero is first put on the target instead of on the aiming point as is necessary with our telescope. This always leaves zero near the target, an advantage in measuring later deflection changes to other targets. Furthermore, as is well known targets are usually indistinct, hard to find and difficult to designate, whereas aiming points are usually selected for their prominence and are easy to designate. The non-commissioned officer at the instrument is more apt to make a mistake in locating and identifying a target than in identifying an aiming point. The battery commander can prevent this mistake and save the time required to designate the target by laying the battery commander's telescope or aiming circle on the target himself, the non-commissioned officer having first set the instrument at zero in the general direction of the target. Valuable time is thus saved and if the wrong target is taken the fault is with the battery commander.

The magnetic north is used as an aiming point when it is impossible to see the battery commander's station from the battery and it is also impossible to so locate the second aiming circle that it can see the battery or be seen from the battery commander's station. The method is as follows: (Fig. 12) R_1 sets at zero, brings the line of

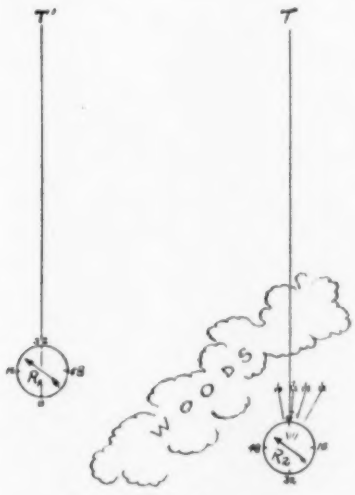

FIG. 12

sight on the target and makes the correction for the offset with the slow motion screw. The magnetic needle is then unclamped, and the top disk of the magnetic box is revolved until the north pole of the needle coincides with the N notch of the disk. The deflection is then read and sent to R_2, who adds 3,200 and sets his instrument at this reading, releases the magnetic needle, rotates the top disk of the magnetic box until the N pole of the needle and the N notch of the disk coincide. He then releases his instrument and sights at the sight of each gun in turn calling out the deflection. The gunners set off this deflection and lay on R_2 as previously indicated. With the German instrument which is graduated from 0 to 3,200 in each semi-circumference, 1,600 being parallel to the line of fire, it is unnecessary for R_2 to add 3,200 to the deflection sent by R_1 (Fig. 13).

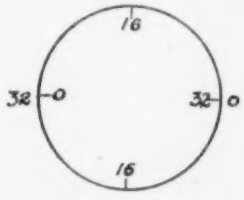

FIG. 13

RANGE FINDERS, TELEPHONES, EMERGENCY SIGHTS, ETC.

The Firing Regulations then give the instructions for training in the use of range finders, telephones, emergency quadrant and emergency sight and quadrant for the howitzer. A discussion of these will be omitted, being either practically similar to or otherwise not pertinent to our matériel.

BATTERY TRAINING.

Prerequisite to success in battery training is a thorough individual instruction. The object of this training is gradually to accustom the men to service conditions by a great variety in situations, by exercises over varied terrain, and to perfect the battery as a firing machine. Especial value is to be found in exercises involving fire discipline, conduct of fire, service of reconnaissance and communication. Battery commanders must purposely seek difficult situations, for the purpose of testing the initiative, resourcefulness and training of the various individuals and units of the battery. There must be frequent practice in intrenching, especially of the battery commander's station.

The battery commander is responsible for the training of his officers and non-commissioned officers, both active and reserve, in the conduct of fire. He must insist upon quick and positive decisions in observation of fire and must train his officers to give their commands in clear and proper form so that the battery will understand their intentions. Repeating commands or correcting mistakes by changes in commands, will lead to confusion and poor fire discipline. Whenever possible it is, therefore, best to permit a mistake in the command to go on through, making the necessary correction in the next command. The battery commander gives his commands personally only when he can control the battery with his voice. Frequent practice should be given the executive officer or the officer nearest the battery commander's station in transmitting commands. Commands should not be given just as a shot is being fired. Designation of targets should be clear, definite and concise. The use of aiming points and the effect of their location upon the distribution must be thoroughly understood and mastered.

In practice when communication is by telephone or semaphore, it is required that all commands be recorded, both at the battery com-

mander's station and at the firing battery, in order to permit comparison and discovery of errors after the exercise. Change of target should seldom be made by determining a new deflection but rather by an appropriate addition or subtraction in deflection. In measuring the amount of change, the battery commander must keep in mind his position with respect to the firing battery. If the battery commander's station is in front (rear) of the firing battery, the angle will be measured too great (small). When the difference in range between the old and the new target is great and the battery commander's station is at a considerable distance to the right or left front of the battery, this error may be very large.

BATTALION TRAINING.

The first battalion exercises in preparation for fire, fire control and direction, are conducted with the selected personnel only, that is, with the officers, details, observation wagons, etc. For this work, localities should also be chosen which are ordinarily inaccessible or not available for maneuver with the batteries. The winter months are best suited to this work, because in this way uniformity in the battalion is assured before service battle practice is begun.

The duties of the battalion detail should be properly classified and assigned. One officer of the battalion commander's staff should always keep himself informed concerning the state of the ammunition supply, and how it may be replenished at any time.

The battalion commander must give variety to the training by frequent changes in the tactical situation. However, in any one exercise, it is best to represent a particular phase of a fight and to carry this out to its tactical completion.

One officer should always supervise the measures for and the establishment of communications. The same also applies to the location and protection of both the battalion commander and battery commander stations. The battalion commander must frequently bring up situations in which he himself designates these observing stations or in which he leaves their choice to the battery commanders themselves. In the latter case he will very often have to give them more detailed instructions so that they will act with understanding.

The tactical fire direction is the most important part of the battalion commander's duties. When his battery commanders' stations

are distant from him, his difficulties will increase. In practice exercises he must, therefore, purposely introduce such difficult situations in order to promote resourcefulness and skilfulness in overcoming these obstacles. He must have frequent practice in designating principal and auxiliary reference points and to locate targets, sectors and zones with respect to these points or to other targets. In designating a new target, he should always give the approximate range to the new target.

PATROLS, SCOUTS, AUXILIARY OBSERVERS, ETC.

Their duties are the same as prescribed in our regulations. Although men are usually assigned to normal duties, these duties will depend so much upon circumstances and merge into another, that it is advisable to train these men in all the duties. In order to assure uniformity, all of this instruction in the battalion should be under the supervision of one officer. This instruction includes:

Map reading; use of maps; orientation; identification of points of the terrain on the map and the location of points of the map in the terrain.

Ability to choose vantage points, facilitating the reconnaissance of the hostile sector or terrain.

Careful use of cover.

Spotting troops or battle targets; location of same based upon the reports of air scouts or from panoramic sketches; ability to recognize the kind and extent of target (also as indicated by signs of dust, smoke, or flashes); demonstration and knowledge of how different hostile troops will utilize the terrain; places where hostile artillery can take position and where to look for their observing stations.

Relocating targets and reference points that were previously identified from some other point.

Reports and messages, how made, etc.

Estimation of distances.

Position and panoramic sketches, and their use.

Plotting positions and location of troops, etc., on the general staff map.

Discussion on the methods of war, organization and armament of foreign armies, especially concerning the Artillery.

FIRING PRACTICE.

The all importance of proficiency in firing makes it necessary that every means should be provided by higher commanders to give the Field Artillery the necessary time and place to conduct its firing practice. This firing practice must be made as instructive and as near service conditions as possible, to which end a complete outfit of targets must be constructed. In placing and setting up these targets, the greatest ingenuity will be necessary in order to make the best use of the target range.

The following officers and men shall be given opportunity to fire:

(a) In fire direction and control of a battalion: All battalion commanders, staff captains and battery commanders near promotion.

(b) In conduct of fire of a battery: All captains except the staff captains near promotion; 1st and 2nd lieutenants, including battalion and regimental adjutants; officers of the reserve; and whenever possible the older ranking non-commissioned officers.

(c) In conduct of fire of a platoon (section): As many non-commissioned officers as possible.

In the German Field Artillery, firing practice is divided into two distinct phases: (a) Instruction practice, usually only for the battery; (b) battle practice, for both battery and battalion, and for higher commands.

INSTRUCTION FIRING PRACTICE.

This practice may be held at any time of the year. The time, place and number of practices are designated by the regimental commander. He also indicates the general requirements and the steps to be taken to correct deficiencies; he allots the ammunition to each organization according to deficiencies which he has observed, always keeping in mind that the same fire efficiency and uniformity must be sought in all the batteries. He permits no other exercises to interfere with the technical firing instruction remembering that tactical exercises are not now in place. The instruction practice itself is, however, conducted by the battery commander without any interference from anyone. Its purpose is to enable the battery commander to complete the education of his recruits, to train his officers, non-commissioned officers and men in a progressive manner in preparation for battle firing practice; to give elementary practice and training in conduct of fire to junior lieutenants, ensigns and non-

commissioned officers, and to give the battery commander elementary practice in fire direction and control.

The position is always reconnoitered and occupied in accordance with some tactical situation, after which the firing is conducted without regard to any situation. For the first few practices, direct fire positions are occupied, so that the recruits and other men may obtain an idea of artillery fire and an actual representation of the elements and theory of artillery fire. The laying is usually indirect. All changes are explained and attention is called to the results to be expected. The firing is conducted alternately by lieutenants and non-commissioned officers. They are given simple problems to obtain adjustment and later to pass to fire for effect. The elimination of ineffective ranges is frequently practiced. This occasion will be used to explain and demonstrate the use of the regulator (corrector) and its effect upon the height of burst, estimating the height of burst, the effect of difference of level of the wheels, error in the angle of site, errors in changes of deflection, range, fuse setting, etc. For this purpose, the battery commander will frequently interrupt the firing in order to make his explanations, corrections or criticism immediately following the occasion or the shot which caused the discussion. He also designates an officer or non-commissioned officer to observe the fire discipline of the battery and the service of the guns, or he may do so himself, in order to discover any deficiencies or lack of proper team work.

Instruction practice in the battalion offers an opportunity to practice all the phases of preparation for fire and later fire direction. It is directed by the battalion commander. The greatest benefits in this instruction are found in the practice given battery commanders to pick up targets designated by the battalion commander who is at a distance from his battery commanders. For this purpose only a few shots are necessary. Targets need be very simple, very often the designation of a point of the terrain will be sufficient. This practice may also be conducted with skeleton details; that is, the battery details and one gun section per battery.

For battery instruction practice, the targets should gradually be made very difficult and approximate service conditions as closely as possible. To give variety in the identification of reference points, designation of targets and reconnaissance of sectors, pieces of scenic property which can be easily moved, such as wind-mills, hedges,

houses, walls, trees, etc, should be constructed of wood, canvas and brush, and distributed over the terrain.

BATTLE FIRING PRACTICE.

Battle firing practice is the culmination of all firing instruction, just as the annual maneuvers are the culmination of all maneuver and tactical instruction. The purpose of this battle firing practice is to teach officers, non-commissioned officers and men to apply what they have learnt in instruction practice to situations and conditions that approximate as nearly as possible those of actual war. Whereas in instruction practice all tactical considerations are more or less disregarded, they become the very essence of battle practice. A mission should never be made known until the time has arrived for its solution. In accordance with the situation, the officer directing the fire will represent himself as commanding general, artillery commander, communication officer, courier, etc., and thus create situations requiring immediate judgment and independent action by the officer firing.

Everything which approximates the realities of war is permitted. Observing stations, battery stations and the firing battery must be properly protected or intrenched. The officer directing the fire will appoint an umpire who shall go about the position to cut telephone wires, rule out observing instruments, "kill" certain members of the battery detail or even the battery commander himself. He waylays limbers and caissons to prevent the replenishment of ammunition, "kills" certain cannoneers, gunners, or even the chiefs of section or platoon; or he may go along and rule a gun out of action due to a direct hit or a shattered wheel, another for a sight out of order, necessitating the use of some other aiming device. In fact any event which is likely to happen and disturb the fire discipline and conduct of fire, may be introduced in order to make this battle practice as real as possible.

To test the tactical skill of the battalion commander and the battery commanders, several targets are made to appear simultaneously, the idea being to see whether the targets will be chosen in the proper order in point of danger or in accordance with the tactical situation, or having in mind the amount of ammunition available. For this reason more targets than will be fired upon, should always be set up. The director of the firing practice may, after the tactical decision has

been made, call off the firing or suddenly introduce some new situation.

Battery battle firing practice is generally directed by the battalion commander, occasionally also by a senior staff captain. The problems are such as to represent the action of a battery as a part of a battalion. The tasks should gradually increase in difficulty.

Battalion battle firing practice is under the direction of the regimental commander, occasionally also under the second in command or a senior battalion commander. In order not to deprive the batteries of the great benefits of battle firing practice, it will usually be impossible to carry on a great number of battalion battle problems, and very seldom will it be possible to carry out such a problem to its tactical conclusion. Great ingenuity must be practiced in simulating or representing such events and situations as will most likely take place. For instance, agents and umpires should be detailed and originate reports or orders concerning the effect of hostile artillery fire, action of our own and the hostile infantry, ammunition supply, losses, etc., whereupon the battalion commander must decide either to act himself or to report to the next higher or the proper commander.

The Firing Regulations also prescribe a limited amount of terrain firing (*i. e.*, firing without targets); also firing practice within commands larger than a battalion, stating, however, that on account of the limited amount of ammunition, it will only seldom be possible to have such practice for regiments and brigades. At the School of Fire such practice is part of the instruction program and is carried out annually both for regiment and brigade.

FIRING REPORTS, RECORDS, CRITIQUES, ETC.

The Firing Regulations contain model sheets showing all the details in making the proper records of firing practice. The details of these reports and records need not be discussed here because they are more or less like the records made at our School of Fire.

The annual allowance for instruction and battle firing practice is about 700 rounds per battery. Additional allowances are also made for special purposes and experimental firing. With such an allowance and such a system as above described, carried out in all its details to a methodical conclusion, extraordinary efficiency and gratifying results are sure to be obtained.

The German Field Artillery has a great advantage in that it can hold a great part of its firing practice in a different locality each year. This gives great variety in the instruction of officers and precludes the possibility of them knowing the range. The precautions for safety are strict. The civil authorities by proclamation inform the inhabitants of a particular district concerning the limits of the danger zone, the hours and the dates on which the firing will take place. The people are warned not to pick up or dig up any fuses, cases or unexploded projectiles. This is an offense punishable by law. The finder is required to inform the range guard or the local police of the location of such unexploded projectiles or fuses as he may have discovered. A reward of one mark is paid for the discovery of an unexploded projectile, and of one-half mark for each unexploded fuse or for a projectile without a fuse. This same reward is also paid to members of the range party that police the vicinity of the target area after each firing. All empty cases and exploded fuses are collected and cleared away. Unexploded projectiles and fuses are immediately disarmed or exploded by the organization. If unexploded projectiles are found after the departure of the organization from the locality used as a range, the local civil authorities are required to inform the organization by telegraph of the discovery of such armed projectiles or fuses, whereupon a detail is sent to disarm or explode them.

It seems unnecessary to make comparisons with our own service because conditions are so unlike. We have a splendid "Drill Regulations" which reflects the high professional ability of those who prepared it. But we have not the military system to carry out its spirit. Though our officers and non-commissioned officers may have the genius, they lack the experience and what is more, the opportunity to carry out an intensive method of individual instruction and education. This can be corrected only (a) by the simultaneous arrival of all the recruits for any particular year, assigning them upon arrival all to one or at most to two organizations; (b) by preparing and training before the arrival of the recruits, the necessary personnel in officers and non-commissioned officers with qualifications as recruit instructors; (c) by prohibiting for the first six months all so-called battery drill and tactical exercises for recruits, as well as anything else that will interfere with their thorough individual instruction; and by a lot of other measures which might easily be initiated if we showed a little more inclination and made an honest attempt.

FRENCH ARTILLERY—THE HEAVY FIELD BATTERIES.

By George Nestler Tricoche, Late Lieutenant French Foot Artillery.

When we consider the achievements of the German Heavy Field Artillery in the present war, it is natural that the question should arise: Have the French been hypnotized by their 75-millimeter gun so as to become blind to the advanges, on the battlefield, of a lare proportion of Heavy Artillery? Did they renew to some extent the fatal mistake of 1870—a time when they were too proud of their famous "rifled 4" of 1859 to pay any attention to breech-loading guns? We do not believe that such is really the case—although there might be a wee bit of truth in the charge. Things in 1914 are widely different from what they were in 1870. At the eve of the Franco-German War, France had not improved her Field Artillery for eleven years, in spite of evident progress made not only by Germany, but even by small nations of Europe, such as Switzerland—a militia country. The Artillery Board, following a policy as indefensible as it was dangerous, well deserved the epithet of "stultified" that was afterwards lavished upon that body.

Now, in late years, and especially since 1900, the French Field Artillery strove valiantly to keep the superiority which it had attained over the German Artillery in 1898, and which it was threatened to lose. It brilliantly succeeded in establishing this superiority on a new impregnable basis, by the master stroke of 1913.[1] But this was effected partly at the expense of the development of Heavy Artillery, because all the efforts, all the enegy of artillerymen were bent towards one goal: the supremacy of the 75-millimeter gun.

There is, it seems, another reason for the comparative neglect of the howitzer and heavy batteries in general. In the mind of most French artillerists, this kind of matériel is always more or less associated with the idea of sieges. A great many officers were already bemoaning the heaviness of the seventy-five millimeter matériel; any innovation that did not lead towards an increase in mobility was almost abhorrent to them. In fact, the few heavy batteries which had appeared from time to time since 1879, and which consisted of foot artillery officers and cannoneers and light artillery drivers,

[1]Described in the Field Artillery Journal of July-September, 1914.

were generally known as "siege batteries." They were looked upon as "units de luxe"—so to speak—that could hardly be used except in the sieges of Strasbourg or Metz; and such sieges were problematical. It must not be forgotten that although French officers never ceased to hope for the recovery of the "lost provinces," they believed that, the German concentration on the frontier being more rapid than their own, the first and perhaps the only decisive battles would, in all likelihood, be fought upon French soil. Siege operations were left with the German!

This was not, perhaps, a very broad, enlightened strategical conception; yet it was prevalent in army circles for many years, and certainly had an influence upon the organization of artillery.

Lastly, many artillerymen—even among the most progressive ones—were opposed to heavy batteries on purely technical grounds. They said the range of their 75-millimeters equals that of the heavy howitzers, and that the projectiles are undoubtedly more efficient than those of the ordinary German field gun, and that the German, by creating a strong heavy artillery force, only endeavored to neutralize these advantages of the French. The creation of a heavy branch of the arm would be a servile and useless imitation of the German organization.

Therefore, it would not be fair to consider the Artillery Board as being alone answerable for what could be termed the tardiness of the French army in recognizing the usefulness of heavy field artillery.

Be that as it may, a few years ago the War Department was compelled to give its attention to the question, for some uneasiness was becoming noticeable in army circles as well as in the press and at the Parliament on account of the development given by the Germans to the Heavy Artillery.[2] Austria had followed suit. Even the militia of Switzerland had organized twelve rapid fire howitzer

[2]For years, in the German Artillery, efforts had been made to impress privates themselves with the idea that the French "seventy-five" would not have any chance against the *Haubitz-Abtheilungen*. As Colonel Feyler, of the Swiss Army, says in the *Bibliothèque Universelle* (November, 1914): "Battery commanders kept telling their men: 'The French contend that their projectile is more efficient than ours . . . . But real efficiency can only be expected from heavy Field Artillery, such as our 105 howitzer. Then one possesses efficiency by the side of mobility.' The French failed to see this logical distinction. They are content with singing in every key the praise of their wonderful 'seventy-five.' *Französische Prahlerie! Bei uns die Deutsche Grundlichkeit!*"

batteries attached to the infantry divisions, besides its three battalions of 120-millimeter guns.

Therefore, a new gun, the "long" field 105 millimeter, was constructed, tried, and adopted in 1913. Early in 1914, five heavy regiments were created. As in Germany, they were to use two calibers: the new 105 "long" gun, and the "heavy" howitzer of 155 millimeters (Ramailho model). The new regiments were made up, partly, of batteries taken from Foot Artillery regiments.[3]

But there is a wide difference between the German and the French organizations. The former distributes as a rule the heavy batteries among the army corps; in the latter, only the long range battalions (105 "long") are attached to army corps; the howitzer battalions are kept at the disposal of army (not army corps) commanders.[4] But French artillerists observe that, in order to destroy both personnel and matériel of a shielded field battery, heavy shells are not necessary. The only requisite is that the projectiles should hit their tagret. Now, to do this, especially if the taret is well difilated, it is necessary to use much ammunition—which is possible with a reasonable number of caissons, provided shells have *just enough* power, so that there will be no waste in space or weight. General Langlois was under the influence of this belief when he spoke in favor of the "pom-pom."[5] The 75-millimeter batteries, it is thought, are sufficient to overcome the German light artillery. It is, therefore, advisable to limit the use of heavy howitzers to the attack of particularly strong positions; and as this is a somewhat exceptional situation, such batteries must remain in the hands of the army commander, who can dispose of them as he sees fit.

On the contrary, the long range gun (such as the 105 millimeter) when the war broke out, seemed to have its natural place in the different army corps, because it can execute an effective *cross fire* against the hostile batteries opposed to the 75-millimeter.

[3]For instance, the 3rd Heavy Artillery received three batteries from the 3rd Foot and one battalion of three 155-millimeter batteries already existing, as an experiment in the 32d Light.

[4]This divergence of views reminds one of a famous controversy of the eighteenth century—power *versus* mobility. Some officers, headed by General La Vallière, wanted the whole field artillery of an army to be concentrated into a park, at the disposal of the army commander; others were in favor of very light pieces, *à la suédoise*, divided between brigades and even regiments or battalions. This controversy lasted until the Gribeauval system of artillery was adopted.

[5]See THE FIELD ARTILLERY JOURNAL of October-December, 1914, pp. 577, etc.

This can be done almost everywhere, under average atmospheric conditions. So the army corps commander should be able to use his long range guns at any time, and without delay—exactly as he disposes of his corps artillery. In the opinion of experts, the army corps is the smallest unit to which these batteries should be attached: division commanders would not have as a rule good opportunities to use them, because the front of the division is not great enough to permit an effective artillery cross fire.

Yet, inasmuch as the use of long range guns is concerned, the question is not as simple as it seems. What we have just described is called the general use of these batteries. They also have a special or particular use. This occurs when it is possible to fire at very long range for the purpose of compelling hostile colums to leave the roads, deploy and advance across fields, or else to change direction and make a detour. In that case, long range guns could be used to advantage only by army commanders. Should not some batteries at least be attached to army corps, and should remain, like the heavy howitzer batteries, at the disposal of army commanders? On this point officers do not agree. Most of them, however, do not think this is necessary. According to them[6] the special or particular rôle of the long range batteries is somewhat exceptional. In case of need, the arm commander can send for the batteries attached to one of his army corps. It could be ordered, in anticipation of such a requirement, that these batteries should march ahead of the corps artillery.

Requisites of a long range field gun. Granted that the moral use of this gun is the one known among French artillerists and described above as general (cross fire), what are the requisites of such a gun? First, we must bear in mind that cross fire is much in favor in France. The Firing Regulations for the seventy-five-millimeter (Chap. V, No. 13) state that: "Cross fire (*Le tir d'écharpe*) is the most effective. One must use it, even if this fire has to be superposed on others, executed directly. The conditions for a *tir d'écharpe* are fulfilled to a certain extent, when battalions, placed on the same line, are crossing their fire."

The front of a division seldom exceeds 5 kilometers. Therefore a 75-millimeter battery, placed at the wing of a division could hit guns posted at the opposite wing of the hostile division, because the

[6] *France Militaire*, March 21, 1914.

range would be below 7 kilometers—the longest range permitted by the 75-millimeter carriage. The efficiency of cross fire increases with its obliquity in respect to the front fired at. Long range field guns placed at the wing of an army corps 8 to 10 kilometers wide would reach the artillery at the opposite wing of the hostile army corps, provided their range be 9½ to 11 kilometers. This is the first requisite.

It goes without saying that this, alone, should preclude the assignment of this kind of guns to an army only, since their range would thus have to be greater to 11 kilometers—which seems to be almost impossible for field guns.

The second requirement is that the long range gun must not be heavy enough to handicap the army corps operations. It must be remembered that the 75-millimeter itself is considered heavy, although the gun, with its carriage, without limber, weighs only 2,640 pounds, and with the limber, 4,114 pounds. What would be the *desirable* weight of a long range gun? First the limber can be reduced to 660 pounds by not using any chest. If the gun with its carriage weighs only 4,180 pounds, the *voiture-canon* (gun, carriage and limber) would not exceed 4,840 pounds—which is the weight of the *voiture-canon* of 75 millimeters, including cannoneers, their knapsacks and rations.[7] The only difference is that the long range limber carries no extra weight of any kind.

Now, two questions naturally arise. Is a gun of 4,180 pounds too heavy for field operations? Is it possible to have an efficient long range gun that weighs only 4,180 pounds?

As regards the first proposition, there is no divergence of opinion, because this gun cannot be exactly compared with the 75-millimeter from the point of view of mobility. The former would not be called upon to move as quickly and as often as the latter. But all ordnance officers are not sure that a 4,180-pound field gun would be efficient at 11 kilometers (12,023 yards). Many think it would be wise to sacrifice 1 or 2 kilometers for the sake of mobility.

Does the new Franch 105-millimeter gun possess the requisites of an efficient long range field gun? The 105-millimeter is a very new gun indeed: therefore much remains to be learned about it, from the teachings of the present war.

[7] Lieutenant Colonel Paloque, in the paper printed in the FIELD ARTILLERY JOURNAL for July, 1914, p. 345, states the weight of the *voiture-canon* of 75 millimeters, at 4,642 pounds only. It seems this does not include the knapsacks, and rations.

The "105" was made to a great extent on the pattern of a 176.7-millimeter gun ordered in France for the Russian Army. Its muzzle velocity is 570 meters, and the shell weighs 35.20 pounds. The carriage has the same characteristics as that of the 75-millimeter as regards, for instance, the carriage's sliding upon the axle *(coulissement sur l'essieu)* and the stability of the trail blade. It is a quick-firing gun, although the shell proper is separated from the propelling charge and thus the loading requires two motions. The extreme range is said to be "certainly superior to 10 kilometers." The rear carriage weighs 5,062 pounds. Now, we have just seen that 4,180 pounds seems to be the maximum weight possible for a long range field gun that is really mobile. The 105-millimeter exceeds this by 882 pounds. Some artillery officers[8] think that mobility has been needlessly sacrificed for the doubtful advantage of obtaining a range "certainly superior to 10 kilometers," and therefore greater than that of the 10-centimeter gun of the German. Little was known about the 105-millimeter gun at the time the war broke out; but should its range reach 11 or even 12 kilometers, there is not much to be gained by it if the gun cannot "make a hill" at a critical moment, or is delayed by muddy roads. The fact that it may be somewhat lighter than the corresponding German gun is not comforting: the question is not to be less clumsy than one's adversary, but to hit him at the right time.

Composition of a Battery of 105-Millimeter Guns. It must not be forgotten that the following considerations are purely theoretical. They are, so to speak, ***desiderata*** expressed by artillerists at the eve of mobilization. There should not be more than three guns per battery so as to increase the number of caissons—the latter not being able to carry as much ammunition as in the 75-millimeter batteries. On the other hand, a two-piece battery would require too many officers and noncommisisoned officers. There should be thirteen caissons. (It is, however, likely that the present batteries have been organized on the pattern of the 155-millimeter howitzer batteries with four guns.) Each gun must be provided with drag-ropes (*bricoles*). These are necessary sometimes to facilitate the limbering up on sandy or muddy ground, and always to cause the piece to pass from the firing to the marching position and *vice versa*. This has to be done in order to obtain a better distribution of weight

[8] *France Militaire*, March 31, 1914.

between the front and the rear carriages. By leaving the gun in the firing position, too much weight would rest on the front axles; but if one draws back the gun by hand on the carriage slide *(la glissière de l'affût)*, more weight rests on the limber. In fact, all 105-millimeter guns have drag-ropes.

Long range guns have to be still better defiladed than the light field guns, for three reasons. First, the flash and the smoke rise higher than those of the 75-millimeter gun. Second, during the cross fire—which is its normal function—it is absolutely imperative that the gun should not be seen by the hostile light batteries, which might otherwise attack it directly at a comparatively short range. Third, it must never be forgotten that changes of position should be avoided as much as possible especially under hostile fire, for the limbering up is more complicated and longer than that of the lighter guns; the effort required from the cannoneers has been estimated at 380 pounds. Consequently, with the 105-millimeter gun, indirect laying will be the rule; the gunner, nearly always unable to overlook the field of action, must be given a means of choosing an aiming point directly in the rear, if necessary. That is why the 105-millimeter gun has been provided with a panoramic sight.

Fire Adjustment. Firing, as they do generally, at long range, the 105-millimeter batteries must possess powerful telescopes. This is considered extremely important—so much so, indeed, that some officers are in favor of a special wagon carrying a very large instrument. A writer went as far as to say:[9] "We should not hesitate to sacrifice one gun per battery, rather than to do without a telescope wagon."

Can aeroplanes be used to adjust the fire of long range guns? The Regulations for the 75-millimeter say[10] "It is mostly at medium range that aeroplanes can be used for adjusting the fire. At long range, 'the conditions of visibility of the objective make the use of aeroplanes more uncertain.'" However, if artillery avions succeed in getting near enough to the hostile batteries, they may make good observations, because the bursts of the 16-kilogram shells of 105-millimeter guns are much easier to see than those of 75-millimeter shells or shrapnel. Perhaps it will be sufficient for the aviator to take position at a medium distance between the long range battery and its objective—for instance, *above* 75-millimeter

[9] *France Militaire*, March 31, 1914.
[10] Chap. IV, Annex IV, No. 2.

batteries firing directly at a range of three or four thousand meters, while the 105-millimeter gun is executing its cross fire at 9,000 or 10,000 meters.

It has also been said that when a 75-millimeter battery is firing directly at the same objective as the one chosen by a 105-millimeter battery the observations made by the former should aid in adjusting the fire of the latter; if the captain of the light battery has succeeded in getting a fairly good bracket, the range found by him, plus the distance between this battery and the heavy one, should give to the captain of the latter a good base for ascertaining his own range.

Transportation of Cannoneers in 105-Millimeter Batteries. This part of the question does not seem to have received the attention to which it is entitled. Regular tractors are likely all reserved for heavier guns than the 105-millimeter. Therefore, cannoneers of long range field guns must either walk or crowd themselves on the caissons. We have already seen that it was advisable to remove the chest from the limbers of the *voiture-canon*. Neither solution is satisfactory. If the writer may be permitted to mention his own ideas on the subject, a better solution could be found in *mounting* the cannoneers. This seemingly paradoxical innovation—the heavy horse battery—would not only increase the general mobility of units which are naturally heavy, and at the same time may have to cover much ground on the battlefield: it would also help out, at critical moments, the cumbersome *voiture-canon* over a slope or across bad ground—because cannoneers' mounts, in the French horse batteries, are all provided with a small breast-piece and traces *(faux-poitrail)*, so that in case of extreme emergency these saddle horses might be used as draft ones.[11]

Objections to Long Range Field Guns. These objections are serious, and fully to appreciate their worth we lack something which we are not likely to get before the end of the present war—the teaching of experience. Theoretically there are six drawbacks to the 105-millimeter field gun.

First. To execute their cross fire, the 105-millimeter batteries will often stand in a very oblique position in respect to the general front of the line. Therefore, their flank will itself be exposed at medium range to the direct fire of hostile light batteries. They

[11]It is not known at the time of this writing whether the Artillery Bureau, at the French War Department, has considered this proposal.

will then be at a great disadvantage, because they cannot change their position as easily and quickly as lighter field batteries.

Second. Defiladed as they may be, they might be discovered, as 75-millimeter batteries are, by hostile avions, unless they occupy positions so far back of the battle front that the benefits of a real cross fire will be greatly diminished.

Third. At 10, 11 or 12 kilometers, the visibility of the objective requires very good atmospheric conditions. It will probably be more difficult for the battalion or battery commander to see his target than to observe the bursts of his 10-kilogram shells.

Fourth. Thirteen caissons per battery are asked for. But this makes only one caisson more than for the 75-millimeter battery; yet it is obvious that the caissons of the 105-millimeter gun cannot carry as many rounds as those of the 75-millimeter. Moreover, there will be one chest less per section if the front carriage of the *voiture-canon* is to be made lighter. On the other hand, if the number of caissons is increased, one runs the risk of hampering the movements of the whole army.

Fifth. The opponents of the 105-millimeter gun have but little confidence in the possibility of an efficient cross fire by such batteries. According to them, the 105-millimeter gun should use "normal" or direct fire either against hostile light batteries, or against heavy guns in order to protect the advance of 75-millimeter batteries. All this could be done only in very open country. Short or medium range firing with the 105-millimeter gun is out of the question, because the trajectory of this gun would be too flat to permit any real defilading.

Sixth. The staunchest supporters of the "pom-poms" are as a rule the bitterest adversaries of heavy artillery. They contend that what is needed on the battle field is a large number of small but efficient projectiles, rather than a limited number of big shells which are often too powerful for the object in view. To use the expression of one of these officers: "It is not necessary to take a club to kill a fly." It has been said that heavy shells have a demoralizing effect upon the morale of hostile troops; but which is more demoralizing, a few large shells exploding once in a while or many small projectiles falling everywhere and almost simultaneously?"

In short, the opponents of the 105-millimeter field gun assert that the number of such batteries should be *very limited*—at least, such was their opinions when the war broke out.

RETROSPECT OF THE DEVELOPMENT OF THE GERMAN FIELD AND SIEGE ARTILLERY IN THE PAST TWENTY-FIVE YEARS.

I. FIELD ARTILLERY.

By Major General Richter.

Translated by Second Lieutenant C. A. Baehr, Twenty-second Infantry, from Artilleristische Monatshefte, June, 1913.

On June 15 the Emperor can look backward on a reign of twenty-five years. During this period, under the blessings of peace, knowledge, art, science, agriculture and commerce have flourished beyond all expectations. That this progress might continue undisturbed by hostile inference, we have been required to maintain a force on land and sea that compelled the respect of our neighbors. While thus furnishing protection for the development of the peaceful arts, the military have drawn upon them for the improvement of itself in matériel and method.

Not only has the Emperor exercised a wide influence over the development of the peaceful arts, but, as war lord, a far greater influence over that of the Army and Navy. He has the power to remove obstacles to progress, to introduce recognized improvements, and to abolish obsolete conditions.

During this period the Artillery has not been backward, but has undergone great changes toward up-to-date efficiency in its organization, armament, instruction and employment. Under each of these four heads will be given the state of preparedness in which the artillery found itself in 1888; and the subsequent development and the conditions influencing it will be traced step by step.

Organization.

I. In Time of Peace.

At the beginning of the period considered, the supreme control over matters pertaining to the field artillery were vested in a general inspection department for field artillery which existed until April, 1889. The four existing inspection departments were then combined to open the way for the establishing of divisions as regards tactical training, organization, mobilization and matters of personnel placed under the control of the general headquarters. This was the

first step in the direction of considering the proper demand of the arm and bringing it into close touch with the leaders and troops wtih whom it must fight side by side in time of war.

The time was not considered ripe for the ultimate step of placing the artillery permanently in divisions, and abolishing the corps artillery, for the latter organization had been proven in the Franco-Prussian War and was looked upon as almost indispensable.

In Bavaria the two brigades belonged as regards tactical and purely official matters under the commanding general, in technical matters and those of personnel they were under the inspection department of artillery and trains. A similar system to the Prussian was adopted on April 1, 1889. In Saxony and Wurtemburg the brigade was the highest unit.

At this time the position of inspector of field artillery for the whole empire was created, and he, under the Emperor, was given charge of the technical matters of the field artillery. He was especially charged with the duty of supervising and conducting fire instruction, and of keeping up and increasing the technical knowledge of the personnel. This one-sided sphere was greatly enlarged in 1893 and again in 1899 when the inspector was above all charged with the promoting of fire-efficiency. As superintendent of the Field Artillery School he was enabled to direct the instruction of the personnel, as well as to add greatly to the efficiency of the arm by promoting improvements in the matériel. In 1912 he was given the right to report directly to the Emperor on matters pertaining to the field artillery.

In Prussia, corresponding to the number of army corps, there were fourteen brigades of two regiments each, eleven brigades of three regiments each; one regiment in each brigade consisted of two battalions of four field batteries, and one battalion of three horse batteries, the others of three battalions of three field batteries each. Exceptions were the Fourteenth Reriment, which had one battalion of horse artillery with its three of field artillery; and the Twenty-fifth Regiment, which had only two battalions of three field batteries each and one horse battery.

In Bavaria two regiments had a strength corresponding to the stronger of the Prussian regiments, and two corresponding to the weaker. In Saxony one regiment corresponded to the stronger Prussian organization. Besides this, Saxony had a regiment of

three battalions of four field batteries each, and Wurtemburg two regiments of three battalions of three field batteries each.

The condition and total of the German field artillery in 1880, and the subsequent increases, are shown in the following table:

No.	Year of authorization and of completion of change	No. regiments	Battalions, field artillery	Battalions, horse artillery	Field batteries	Horse batteries	Total of batteries
1	1887[1]	37	95	15	319[1]	47	366[1]
2	1889	38	106	15	319[1]	47	366[1]
3	1890	43	132[2]	22	390[2]	47	437[2]
4	1893	43	152	22	450	47	497
5	1899–1901	95[3]	184[3]	17	541[3]	42	583[3]
6	1911	95[3]	191[3]	11	579[3]	22	601[3]
7	1912–1915	101[3]	203[3]	11	609[3]	33	642[3]

[1] Including 2 batteries at the school of fire.
[2] Including 1 battalion of 3 batteries at the school of fire.
[3] Including 1 regiment of 3 battalions of 3 batteries each at the school of fire.

The reason for these increases was the fact that the French continued to increase their artillery. Their state of war preparedness became greater than ours since they had the teams for some of their caissons besides those for the guns in their peace establishment. Hence it became necessary for us not only to increase the number of our organizations, but also their peace strength. Teams were provided for the six guns of the batteries of the first line, and for some of their caissons by taking the teams from the batteries of the second line. By this the batteries are better able to provide for proper instruction, and those provided with teams can move out at once on mobilization as soon as the necessary supplies are provided.

In the year 1888 six field and six horse batteries possessed teams for their six guns, but none for their caissons. The advance which has since been made is shown by the fact that, according to the law of March 27, 1911, seventy-eight batteries, including thirty-three horse batteries, shall be provided with animals for six guns, two caissons and four hundred and fifty-six cannoneers each.

The military program of this year plans to provide animals for all batteries for the guns which they will take in war as well as for the observation wagons. Nearly one-half of the field batteries and all of the horse batteries will have teams for caissons; the former three each, the latter four each.

The increase of 1890 was partly the result of the establishment of the Sixteenth and Seventeenth Army Corps. The same year saw the Artillery School separated into distinct schools for the field and siege artillery. The year 1893 was signalized by the establishment of a probational two-year term of enlistment which was to be tried out until 1905.

Due to the various ununiform changes, an undesirable difference in strength and organization developed between the various regiments. Some varied between from three-fifths battalion of from eight to fifteen batteries; some had battalions of two to three batteries of field artillery consisting of three field and one horse battery. The peace strength varied between the widest limits. It became more noticeable year by year that it was impossible to properly supervise, to lead or to train such a mass of units. It was becoming evident that the placing of the arm under a general headquarters had not as yet brought about the desired close relation between the commanders and the three arms. It is only by maneuvers of large organizations that the influence of the division commanders who must handle the artillery in campaign can be of benefit to the tactical instruction of the latter, and the team work with the infantry be established. These influences were lost when the artillery was, as frequently happened, detailed with different organizations from year to year for maneuvers.

It was recognized in 1899 that the existing organization was not worthy of being retained, and that all should work together in time of peace as they must in war. Organizations were made uniform in their strength and were permanently assigned to divisions. After clearly outlining the limits of the authority of the general headquarters and the division commander on the one hand, and of the inspector of field artillery on the other, the division commander was made responsible for the war-preparedness and employment of the field artillery as he had previously been for the other two arms. This gave to the field artillery for the first time its proper place alongside of the infantry and cavalry. In spite of its acknowledged brilliant service in the Franco-Prussian War,

it had been the step-child of the army in matters of organization, instruction and employment; and it was not until nearly thirty years had elapsed since then that it was given its recognition. It is now recognized that the objections against which it had to contend were not always based on good reasons, as is also the fact that great influence was exerted up to the last minute to keep it under the general headquarters. However, appreciating the necessities of the situation, it was his Majesty the Emperor himself who announced the deciding conclusion.

It cannot be denied that the combining of the three arms was productive of great results. Those who contended against it must recognize that not only have the field artillery and the other arms benefited by it, but also the leaders in the new system who have been required to acquaint themselves with the capabilities of this arm and the manner of employing it.

At the time of this change, which it to a certain extent influenced, came the establishing of the Eighteenth and Nineteenth Army Corps with three divisions in Prussia and one in Saxony, the Third Army Corps and a division in Bavaria. This was begun in October, 1899, and was completed October 1, 1901. In Bavaria each regiment of field artillery remained one battery short of the required strength. The brigades were given the numbers of the divisions to which they belonged. They consisted of two regiments each, all of the regiments consisting of two battalions of three field batteries each, the six exceptions having each one battalion of horse artillery. To nine of the regiments was added a battalion of two horse batteries each for use with cavalry divisions. One battalion in each army corps was armed with light field howitzers instead of field guns, the howitzer battalion of the guard corps being stationed at the school of fire.

This would have given us a uniform organization had the newly organized Thirty-seventh and Thirty-ninth Divisions received a brigade of artillery each, but only one regiment each was provided for them, one attached to the First, the other to the Twenty-ninth Brigade.

As shown by the above given table, a reduction of the horse artillery dates from this period. It is maintained now only at such strength as is demanded by the requirements of the cavalry divisions. The reduction was carried further in 1911, but with an addition to each of the cavalry divisions of a battalion of three

horse batteries each, the batteries having four guns instead of six. This was an improvement in organization not to be overlooked, as it points to a recognition of the value of the smaller, more efficient batteries, and of the fact that the formation of divisions with three brigades should be followed by a similar formation of the artillery.

The law of March 27, 1911, added a brigade of field artillery each to the Thirty-seventh and Thirty-ninth Divisions, and changed twenty horse batteries into field batteries. The total of the batteries became five hundred and seventy-six field and twenty-two horse, which stood until the establishing of the six batteries which had been lacking in Bavaria. Before the provisions of the increase had been carried out, the political situation in 1911 demanded a still further increase of the whole army. This was provided in 1912 by the establishing of two new army corps, to which the Thirty-seventh and Thirty-ninth Divisions were assigned. This necessitated an increase in the field artillery of two brigades, four regiments, four battalions and twenty-four batteries. It was also decided that each division was to receive an additional battalion of field howitzers. These changes were to be carried into effect in three years.

When the increase has been carried into effect, the total strength of the field artillery will be, including the instruction regiment, of three battalions of three batteries, fifty brigades, one hundred and one regiments, two hundred and fourteen battalions, six hundred and forty-two batteries. The difference between the strength in 1888, which was eighteen brigades, thirty-seven regiments, one hundred and ten battalions, three hundred and sixty-six batteries, and the above, shows an increase in the twenty-five years of thirty-two brigades, sixty-four regiments, one hundred and four battalions, two hundred and seventy-six batteries. The peace strength in 1888 which, for each battery excepting six of field and six of horse artillery of increased strength, comprised one hundred and five men and forty-three horses, was increased as follows by the Act of April 1, 1911.

Field Batteries.

Reduced strength.....	102 men	53 horses
Medium strength.....	115 men	68 horses
Increased strength.....	127 men	80 horses
Highest strength.....	131 men	87 horses

Horse Batteries Throughout.

Increased strength..... 121 men 125 horses

The increase in the number of horses is due to the fitting out of more guns and caissons with teams, to the providing of a six-horse observation wagon, and to the increase of the mounted men of the "battery troop," who serve as scouts and have charge of the telescope, telephones, and the plotting board. What the strength will be after the adoption of the army program for 1913 is as yet undetermined.

Until 1899 one first lieutenant was provided in each brigade for the corps artillery regiment. In that year a captain was added to the staff of each regiment instead for service with new organizations formed on mobilization. In 1912 one first lieutenant was added to the two captains in each brigade for the same purpose and further additions for that purpose are contemplated.

The reduction of the number of guns in the horse artillery batteries which was accomplished by the act of March 27, 1911, was due to the increase of the field batteries at that time. What its result will be can easily be determined. More thorough instruction of the personnel, stricter fire-discipline, ease and greater certainty of fire direction, greater adaptability to the terrain, less space required; all these are possible in the smaller organizations, and the single gun of the small battery gives a better account of itself than does that of the larger one. It is not to be denied, however, that the change is attended by greater expense per gun, as well as rendering considerable changes necessary in the organization.

II. In Time of War.

Up to the time of the placing of the artillery in divisions, its distribution was so planned that on mobilization the commander of a regiment with two battalions was to be assigned to a division. The remainder of the two regiments, including such horse artillery as was not assigned to cavalary divisions, was combined under the designated first lieutenant as corps artillery. Now each artillery brigade remains with its infantry division except for the battalions of horse artillery required for the cavalry division. In place of having corps artillery, the corps commander may take a portion

of his artillery and place it in reserve under his own orders. In what strength or formation he does this is left to his discretion.

In the organization existing in 1893 the batteries of twenty carriages had become unwieldy and required too much road space in front of the infantry when in column. This led to the taking away from each battery in 1899 of nine caissons and the field forge. In order that the ammunition thus withdrawn should be kept as closely as possible to the battery it was for each battalion carried in a light ammunition train. The forge outfit was carried in the second supply wagon. Of the remaining caissons, three remained with the fighting battery; the other three with the first supply wagon, the officers' and spare horses made up the second echelon. In order that the guns could from the first be kept supplied with the ammunition for keeping up a heavy fire, and to protect the cannoneers who were handling it, the six caissons and the observation wagon were combined with the fighting battery. The first supply wagon, the officers' and spare horses which had belonged to the second echelon were added to the combat train. The second supply wagon, the field and forage wagons became the field train of the battery. The combat train receives ammunition from the artillery ammunition column.

Matériel.

The field piece adopted in 1874, 7.85 centimeter for horse batteries and 8.8 centimeter for field batteries, combined a high-fire efficiency with great mobility, and as regards ballistic qualities it was up to date, even in 1888. The projectiles used were round shell No. 80, shell with percussion fuse No. 80, canister No. 82 and shrapnel No. 86, which latter consisted of two hundred and sixty-two bullets for the 8.8 centimeter gun and one hundred and sixty-seven bullets for the 7.85 centimeter gun. Each shrapnel bullet weighed about two hundred grains.

For some years experiments had been made with compounds that would increase the range and explosive power of the projectiles. In 1886 noticeable results were obtained in France, B powder being adopted there for the propelling charge and melinite for the explosive charge. In Germany the exeperiments were carried forward to the extent of causing the adoption in 1888 of the explosive powder No. 88, which, like melinite, is a picric compound, and the laminated

gunpowder for the propelling charge. The latter was later displaced by the so-called powder No. 96. The new explosive charge burst the shell into a large number of fragments, which attained an unprecedented velocity and which separated over an angle of one hundred and ten degrees. The great expectations which were at first placed on the shell No. 88 were not fulfilled when the material of which is was made was changed from cast iron to cast steel. It was unprofitable as at burst a large percentage of the fragments were too small to possess much destructive power. On account of the steep angle of fall of the lower fragments, it had been expected that this shell would be used against well-protected targets against which the artillery had no other means of attack, but on account of the small number of fragments which were directed downward by the burst, it had to be acknowledged that a large expenditure of ammunition would be required to produce effect with it. After the adoption of the shield for field guns, the shell gained in importance as a projectile for their attack.

The proper protection of the personnel against danger of explosion of the gun in case of detonation of the shell in the bore necessitated the use of nickel steel in the manufacture of the gun. After tests one battery in each battalion was equipped with them.

Great importance was attached to the new improvements in the powder. It gave out almost no smoke, burned with an even, gradually increasing speed, and on account of the greater percentage of gas produced, made greater pressure and consequent higher velocity possible. These changes led the way toward greater improvements in the matériel and an increase in effectiveness. The ballistic qualities could be increased, on account of the small quantity of smoke given out sighting became easier, hence, a higher rate of fire could be maintained, and the concealment of the batteries for a longer time was possible, as the betraying smoke cloud no longer need be counted on. At first the qualities of the new powder were utilized to increase the ballistic qualities of the matériel then in use. But it soon became evident that the increase in muzzle velocity possible was limited by the inability of the gun carriage then in use to withstand a very much greater shock of recoil, and that the projectile then in use was of an unfavorable shape, causing the velocity to decrease rapidly.

Changes were introduced in 1889, and the long cherished desire of the field artillery for a single gun both for field and horse

batteries was fulfilled. Anticipating the possibility of reducing the weight of the heavy shrapnel to that of the shell, it became feasible to reduce the weight of the 8.8 centimeter gun to about that of the 7.85 centimeter. The gun thus altered was known as model 73-88. This change gave the horse batteries a more powerful weapon, and greatly simplified the problem of ammunition supply. The lighter gun could be used with higher velocities without too great a strain being placed on the carriage then in use.

The growing use of covered firing positions favored by the smokeless powder led to a demand for improvements in the methods of indirect laying. The plotting board came into use in 1892 and greatly assisted in the determining of the deflection from aiming points. Although the smokeless powder permitted a more rapid sighting than had been before possible, the rate of fire could not be greatly increased, as there was no way of checking the recoil of the carriage. On Model 73 this was partially accomplished by locking the wheels, a feature that was retained in Models 96 and 96-A. The last mentioned models were adopted as the result of many experiments made to develop a matériel that would enable us to take fullest advantage of the capabilities of the smokeless powder. As regards technical advantages and tactical use, they were superior to the existing types. The great progress made in the quality of the steel opened up the possibility of greatly reducing the weight without impairing the effectiveness of the piece, or of retaining the weight and greatly increasing the power. The Model 96 gun adopted as the result of the experiments was of caliber 7.7 centimeters: it gave a muzzle velocity of 465 meters and used a projectile weighing 6.8 kilograms, both shell and shrapnel. A more powerful charge was used, which with improvements in the ignition and in the shape of the projectile admitted of a longer effective range. The weight of the assembled piece was 1,720 kilograms for field and 1,670 kilograms for horse batteries, that of the dismounted gun, 925 and 875 kilograms, respectively. The maintaining of the position of the piece on firing was not yet possible. The recoil was checked by locking the wheels and by a small plate on the trail. The breech block required but two movements in opening, and the charge was carried in a metal cartridge separated from the projectile. This favored more rapid loading. Sighting was simplified by the adoption of an inclined sight which combined the two previously employed instruments, sight and range quadrant,

and automatically corrected for drift. It had arrangements for setting off deflection and elevation. It could be used in covered positions and at night. This gun could be fired at a rate of eight shots per minute as against a former rate of two and one-half per minute. It was more mobile and more easily handled than was its predecessor and decidely more effective. Its strength and simplicity of construction also deserve mention.

The caisson was also built lighter and could carry a larger amount of ammunition than the former one. The development of the ammunition kept pace with that of the piece. The shrapnel No. 91 consisted of a case of thin steel in which was packed a larger number of bullets than was possible in the earlier type. These were of hard lead, which retained its shape better than did the soft lead of the earlier types, giving greater penetration; they weighed 114 grains each. The weight of the projectile was reduced to 7.5 kilograms. By packing the bullets in a matrix of black powder which gave out a dense black smoke on the bursting of the shrapnel, the observation of the fire was greatly facilitated, and ranging made more accurate. A further step forward was made in the change to a base charge projectile. The bullets propelled by the burst of the base charge attained an increase in velocity of from 50 to 80 meter-seconds over that of the projectile at the moment of burst. This permitted a reduction in the weight of the bullets to 130 grains each and a reduction in that of the projectile to 6.85 kilograms. The number of bullets was increased to 300. The extreme range of the piece was extended to 5,000 meters.

After the fighting around Plevna and the great advances which that brought about in the use and construction of artificial cover, it became necessary to develop means for attacking covered and strongly protected targets upon which shrapnel would have no effect. There were two suggested solutions to this problem: first, firing of the gun with reduced charges to get a high angle of fall; second, the adoption of a gun specially intended for curved fire. The first solution was impracticable, due to the great loss of range and effectiveness which it entailed. The second did not at first fulfill the requirements, as the short 12 centimeter gun which was tried was not found satisfactory, as it could not effectively combat troops. An attempt to solve the problem by the use of high explosive shell with the regular field gun did not prove satisfactory. The demand was at last met by the adoption of a light field howitzer.

Its mobility was to be as great as that of the heavy field gun Model 73. This weapon was adopted in 1898 and was of 10.5 centimeter caliber and possessed great effectiveness. Its weight was kept within the required limits, and it could be loaded with more rapidity than could the Model 96 gun when using horizontal fire. It was held during fire by brakes and trail spade. The shell adopted for use with it weighed 15.7 kilograms, it could be exploded in the air, on impact, or after penetration, the last being accomplished by a delay action fuse. On explosion this shell burst into a larger number of fragments over a larger area than was covered by the field gun shell, the size and the penetration of the fragments were also greater. The shrapnel used with this howitzer weighed only 12.8 kilograms, though carrying five hundred 130 grain bullets. The fuse used could at its greatest length of burning carry for a range of 5,300 meters. Different sized charges were employed so that between 2,100 and 5,900 meters the angle of fall would be always at least thirty degrees. The change from one sized charge to another was made without orders from the battery commander by the second commander, and tables were provided for that purpose. The metal case for the charge and the projectile were separate. One disadvantage of this gun was that it necessitated three kinds of projectiles, two varieties of shell, and one of shrapnel. Of the shell, the high explosive was seldom used, yet in certain cases it was the only one to be used, the other was for common use. The natural result of this was that the battery could be furnished with but a comparatively small amount of each kind of ammunition, and it was probable that in battle the kind most needed would be quickly exhausted. The field howitzer projectile adopted in 1905 improved this situation somewhat by combining the qualities of shell and shrapnel. Its fuse could be set to explode the charge after time interval, on impact, delayed action, or at the muzzle of the gun.

The matériel of 1896 had hardly been introduced before the first field gun allowing recoil of the gun on the carriage was produced in France. According to reports, it could fire thirty shots per minute, the stationary carriage permitted the sheltering of the cannoneers by shields, and the efficiency of the arm was greatly increased. The importance of this new development was so great that Germany was compelled to at once bring her artillery to a similar point of efficiency. As the Model 96 gun lent itself very well to the alterations necessary, the rebuilding of this gun was begun at once. The

change was made with the principle in mind that the recoiling of the piece on the carriage was not to be accomplished at the expense of diminishing the mobility of the gun. This demand was met in spite of the increased weight of shields and recoil apparatus by building a lighter carriage, which was permissible, as it did not have as great a strain to withstand as formerly, and by some decrease of the weight of the gun itself. The ballistic qualities were maintained the same as they were before in the 1896 model. The carriage consists of two parts, the carriage proper, or lower carriage, and the cradle. The gun is held by a clamped plate of steel on the cradle which fits over a rail at each side of and below the gun, and permits it to slide to the rear. A lug projecting down from the gun near the breech is attached to the recoil checking mechanism. On discharge the gun slides to the rear on the rails until the force of recoil is taken up, partly by recoil cylinders and partly by storing up energy in a spring which draws it forward into the firing position as soon as the energy of recoil has been expended. The cradle is so attached to the lower carriage that it may be swung up or down for elevation on trunnions; it also has a slight transverse movement in deflection of about four degrees to each side. The lower carriage is held in place during the firing by brakes and a trail spade. The old breech block, the firing mechanism, and the sights were each changed to adapt them to the rapid firing system. The telescopic sight was adopted to permit rapidity of picking up targets, and two quadrants were added for indirect laying. The shields protect against rifle fire from ranges over five hundred meters.

To take advantage fully of the possibilities for greater rapidity of fire, the charge and the projectile were combined in a single cartridge. The 1905 powder used as the propelling charge was expected to do away with the appearance of any flash at discharge.

The importance of the field howitzer demanded that its rate of fire be increased by the addition of shields and a recoil system to their carriages. The result of the change was the field howitzer Model 98-09. The carriage is very similar to that of the field gun, except that the trunnions upon which the cradle turns in elevation are nearer the breech so that the piece in recoil does not strike the ground except at the highest elevation.

The sighting apparatus consists of a straight and angular sight, a panorama telescope, and a telescopic sight, the latter being pro-

vided to sight on quickly appearing targets and as an aid to the panorama telescope. The quadrant and ordinary sight are for use when the panorama telescope and telescopic sight are unserviceable. Each howitzer battery is equipped with two plotting boards.

INSTRUCTION.

I. Drill.

It was formerly customary to place great importance upon the strictness and uniformity with which all movements were executed. Not only were the strict, detailed drill movements on foot required, which as foundation of all training are still demanded, but also all battery movements were executed in a manner possible only on the parade ground. The regulations in force from 1877 to 1889 were written in that spirit. Those of 1889, 1892 and 1899 contained the drill for the cannoneers, and also the prescription that all movements not prescribed therein were forbidden. In the regulations of 1907 the short direction was given that all movements were to be executed in a free and unforced manner. Drills and formations whose sole object were apeparance and parade efficiency were gradually simplified and eradicated. There were many movements in battery drill whose sole object apparently was to prevent the monotonous repetition of the few movements in drill, and to provide opportunity for a few drill artists to shine on the parade ground. It was not until 1907 that only the movements necessary on the battle field were left in the regulations. To show how the change from drill-ground to battle instruction was step by step accomplished, a few extracts from past regulations will be quoted.

The board which was convened to prepare the 1887 regulations was given as a guiding principle the direction that it should aim at the preparation of the arm for its duties in the face of the enemy. The regulations of 1889 gave as the underlying principle of training the following: "All drills must be conducted with a view to war conditions in which only simple movements produce results. All complicated movements are deprecated. Opportunity must be given the junior officers to learn the handling of a battery. Great importance is attached to handling of war strength combinations. The main thing for field artillery is that it should be able to fire accurately, at the right time, and from the right place."

Battalion drill was retained in spite of the fact that the Prince

of Hohenlohe, general of artillery, in the light of his experience in the field in 1870 considered it no longer necessary. However, regimental drill was abolished as it was absolutely without practical value in the field. The training of the personnel of the horse batteries in attack formations without the guns was abandoned as out of date. The rules of fire disappeared from the regulations. For the first time battalion drills with pieces unlimbered were taken up with the object of building up fire control and understanding between the leader and the personnel, the foundation for definite battle formation. It must be acknowledged that the commission which prepared the 1889 regulations solved the problem well according to the demands of the time. It gave a secure foundation for development of war efficiency, upon which further improvements could be erected as required.

The 1889 regulations were superseded three years later by those of 1892, the change being required by changes in the matériel which required different handling than did the old. They demanded a higher degree of training of the cannoneers in order that any of them might be capable of taking the place of the gunner.

The 1899 regulations were brought out with the introduction of the Model 96 field gun and the Model 98 field howitzer. With its adoption, canister, once heralded as the decisive projectile of field artillery in the days of the old smooth-bore guns, was displaced by shrapnel. A demand for more complete fire control, greater mobility, and a more thorough understanding of the part to be played by the artillery in the carrying out of the plans of the commander-in-chief, arose from the general progress made in the service in the training for war efficiency. Directions are found for the handling of the combat train and ammunition, and for the use of sheltered firing positions adapted to the terrain.

In 1907 new regulations were adopted in order that the many changes necessary to the full realization of the advantages of the new rapid-fire gun might be made at once. Great improvements in the instruction, composition and organization of the batteries was necessary. The underlying principle adopted was more thorough instruction in battle formations and the exigencies to be expected in the field. The necessity for at times moving the carriages by hand, from protected to open positions, for moving caissons to the rear to replenish ammunition, etc., led to the requirement for in-

struction of all cannoneers in the moving of unlimbered carriages, even over difficult ground and with full equipment.

Formations for the drill of the battery mounted were still further simplified, a notable example being the abolishing of the section column formation. The use of trumpet signals in battle was forbidden, all orders were required to be given by signals either by flag or telephone. Close order drill was not allowed in organizations larger than the battery, thus the battalion drill was done away with. Its place was taken by battle instruction in which all the conditions of active service were stimulated.

The introduction of the rapid fire gun carried with it the necessity for a larger ammunition supply available for the firing battery, as the replenishing of it from the rear cannot be always relied on. To provide for this all six of the caissons were required to take position with the limbers. This caused great changes in the manner of taking up and moving from positions.

The introduction of the more elaborate system of telephones, signals and the plotting systems needed for the conduct of fire required a considerable body of mounted men who accompanied the battery commander when he left the battery for observation purposes. The use of an observation wagon for this purpose was prescribed as it was not feasible to carry on this work from other than covered positions. A ladder was carried with the wagon which could be set up in the position to facilitate observation.

The regulations also gave attention to the increasing of the efficiency of the horses. Those of 1899 required that considerable practice be given them in the hauling of carriages properly equipped for the field. Those of 1907 required mounted training of the horses as far as practicable and permitted the placing of remounts in draft only after the second year's inspection. The reduction of the rate of march from three hundred to two hundred and seventy-five paces per minute was made to save the horses from overstrain, conditions of active service were stimulated.

2. In Firing.

The experience of the Franco-Prussian War had clearly shown that simple rules for firing and thorough fire instruction give highest fire efficiency. While the handling of shell was thoroughly understood, considerable uncertainty existed in the proper handling of

shrapnel. Experiments by the troops up to 1888 led to the adoption of a scheme for fire instruction that was adopted in 1890.

The basic principles of fire instruction given in the introduction of this scheme have been copied in all the succeeding regulations on the subject. This stated that uniformity of leadership was the condition upon which depended the full development of the capability of the battery, and the proper coordination of its work when acting in conjunction with several batteries in the larger units. To discourage a narrow following of the regulations the 1907 fire regulations added a statement that the spirit of the regulations was to be followed, but that any modifications which led to quicker development of efficiency were permissible.

The 1890 regulations contemplated the use of four varieties of projectiles: shell, high explosive shell, shrapnel and canister. Shell was commonly used to determine the range for subsequent fire with shrapnel; when the explosion of the former was not sufficiently powerful to make the point of burst visible, the high explosive shell was used for this purpose. In fire for effect it was necessary to place the two kinds of shell accurately into the target; for shrapnel fire it was necessary to bracket to within fifty meters when the range exceeded one thousand meters, and within one hundred meters at lesser ranges on account of the small effective depth of the projectile then in use. A direct bracketing of the target by the use of shrapnel was to be undertaken only when no change of the target was to be expected except one involving very small changes in the range. Many changes in the regulation of the point of burst of the high explosive shell were made from time to time as the unsatisfactory results at first obtained in the use of this projectile were at first considered to be due to inexact regulation of the point of burst instead of to deficiencies in the projectile itself. Canister was retained chiefly on account of the ease with which it could be handled, although the shrapnel with fuse cut to zero could be used up to three hundred meters.

With the adoption of the shrapnel No. 96 and the high explosive shell n/a, the shell was no longer used. It was possible to bracket for range with either of these projectiles as the burst of either could be easily observed. Each of them was more powerful than the projectile which it displaced, the shrapnel contained a larger number of bullets, the shell gave on bursting a larger number of fragments possessing a greater penetrating power. The greater

effective depth of the shrapnel permitted the fire for effect upon the forming of a bracket of one hundred meters or even greater at all ranges, as against the fifty to one hundred meter bracket formerly required. This enabled the battery to open up quickly with fire for effect, and regulations clearly and definitely stated the required standard according to the results of experimental firing at ranges under one thousand five hundred meters. The range was to be bracketed to within two hundred meters. The tendency of the time was thus prominently expressed and a paragraph in the 1893 regulations which were adopted at this time was devoted to "rapidity of fire." In this increase of the rate of fire was required as determined by the demands of the tactical situation to enable the artillery to take advantage fully of opportunities offered in the rapidly changing conditions of battle.

The greater refinements in the formations and dispositions of the troops for battle under modern conditions, and the greater distances separating the hostile forces required a careful reconnaissance by the battery commander before fire could be opened. The directions for this reconnaissance were more definitely stated in these regulations than in the previous ones, and the use of the plotting board in determining deflection for indirect fire by the aid of aiming points was introduced.

A new firing regulations appeared simultaneously with the regulations of 1899, but contained no changes worthy of mention. In the course of the following year a chapter was added on "Firing in exceptional cases," in which the attacks of troops in woods or of batteries protected by shields were discussed.

The introduction of the rapid fire gun 96 n/a necessitated the determination of its capabilities by experimental fire in order that they might be fully realized. The drill regulations of 1907 required that the rapidity of fire possible with the new gun should be utilized to cripple the enemy by sudden, short and heavy bursts of fire by which our infantry is assisted in its advance, or, in certain cases, enabled to advance. The firing regulations which appeared at the same time seconded this requirement in certain cases only.

They provided that the target should be bracketed by the fire of a single piece and that lateral extent should be determined by the fire of a platoon. Group fire could also be used for that purpose as well as to realize full advantage of favorable moments as it permits of quick effect. It did not seem to be understood that

ranging should be conducted with shrapnel, by which means both the range and point of burst could be determined together and the fire for effect hastened. Small corrections which are neglected in war and which lose time anyhow were retained and the rational method of making the corrections from observation of shots was not as yet enjoined.

A proposed scheme given the troops in 1911 carried out the modern views of the regulations and was favorably received. The title given it was "Firing Instructions," instead of "Firing Regulations," the object of the change being to do away with anything in the work which might appear to abridge the freedom of experiment of the battery commander. The methods for determining data were greatly simplified: range and fuse setting were determined together by ranging, small corrections were neglected, and fire for effect was to be hastened in every way. No distinction was made between ranging with shell and shrapnel, methods of attacking fixed and moving targets were coordinated, and indirect fire was simplified. All changes made were in the direction of simplicity, and therefore promise greater battle efficiency. Great attention was given the use of aiming points which admits of more frequent employment of indirect fire. The method of attacking observation posts and headquarters given in the 1907 regulations was given the title of "Echelon Fire" and was prescribed for fire at momentarily visible targets and in certain circumstances, for attack of balloons and the newcomer on the battle field, the airship and aeroplane. Night firing was no longer limited to the attack of targets of great extent whose location was known or had been fixed by daylight, but was extended to provide for the covering by night of stretches of the terrain over which the enemy may be given the technical methods of carrying out the tactical demands as laid down in the drill regulations. To this belong decision as to location of observation stations, methods of communication, assignment of targets, use of the battery troop, and definition of the influence which should be exercised by the battalion commander over the conduct of the fire.

The scheme gave a thorough, comprehensible foundation for fire instruction to meet the circumstances likely to arise in service. That their spirit be fully carried out in the service is the duty of the troops themselves, and of the inspector of field artillery, who for that purpose has the School of Fire at his disposal. The latter

has grown from a narrow and circumscribed beginning to become an instruction regiment. It has at its disposal a wealth of matériel and personnel, and since its removal in 1890 to Jüterbog, is located on a terrain which is unequaled in variety and extent upon which it is possible to conduct field firing under a great variety of conditions. The object of the school is the development of the art of artillery firing according to the technical improvements of the matériel, and the tactical demands of the army, and the dissemination of understanding and application of the existing system throughout the service, promote uniformity of instruction, and insure the prompt adoption of improvements and innovations by the regiments. Two courses of instruction of four months each are provided for older officers, staff officers, captains, and senior lieutenants; and the same for junior lietenants. In the second course for older officers, generals who have come from the cavalry and infantry, and who must handle field artillery in battle, are given opportunity to handle the arm, and to acquaint themselves with its possibilities. Lieutenants, who up to 1892 pursued a course at the Artillery and Engineer School, are now given opportunity of pursuing it at the School of Fire, and are given practical instruction in their duties as platoon and battery commanders as well. A similar forty-five days' course is given every five years to officers furloughed to the reserve.

The imperial order of January 27, 1895, which has had great influence in the development of fire efficiency, is worthy of mention here. It provides that the battery, later extended to include the best four batteries, which is found to be best in fire efficiency shall be furnished with imperial insignia to be worn by the personnel. The battery receives a trophy which becomes its property permanently, and the battery commander receives a souvenir from the Emperor. By this, a healthy spirit of rivalry has been developed which has resulted in great progress in fire efficiency, and the relegating of the close order drill, which up to this time had received greatest attention, to a position of minor importance.

EMPLOYMENT.

The field artillery played a glorious part in the Franco-Prussian War, and it can be readily understood that the experiences gained on the battle field in its employment yielded stubbornly to changes brought about by modern conditions, when new discoveries de-

manded experiments and the adaptation of the old principles to the changing conditions.

The first principle laid down in the 1877 regulations was that as far as the circumstances would permit the employment of a large force of artillery, the enemy should at once be confronted with a superior force of that arm. Hence it should be brought into action in masses at an early period of the engagement, requiring that it be placed far forward in the column when on the march. Centralized control in battle was regarded as indispensable, and employment by regimental and battalion units was the rule. The offensive must in any case attack the hostile artillery, and after establishing itself in the position for opening fire, at least a part of its guns must begin to develop the hostile batteries. Frequent changes of position are required if effective results are to be produced, they are made necessary in the course of the battle by the requirements for supporting infantry in attack and assisting in the defense of threatened portions of the line. The position is determined by the terrain, and the tactical situation. In general, ranges exceeding twenty-four hundred meters are too great to promise satisfactory results. The defensive artillery should only enter into a duel with the assailant's artillery when the prospect of attaining fire superiority is bright. When the attacking infantry appears, the latter must be the objective of the defender's batteries to the exclusion of the hostile supporting batteries until the issue of the attack is determined. The artillery commander must accompany the commanding officer in his reconnoissance and take command of his forces in position after receiving directions as to the part that the artillery is to play in carrying out the orders of the whole command. In choice of positions considerations of effective fire precede those of cover. If the advance in battery or battalion front is made possible by cover of by being beyond the extreme range of the enemy's guns, the artillery should move forward fully deployed. Fire direction remained primarily in the hands of the battery commander. The battalion commander prescribed the kind of fire to be used and designated the targets. He could direct the fire, however, in exceptional cases only. The control of horse artillery in action with a cavalry division was also centralized. Its positions should be so selected that it comes into action early in the engagement, and it should be able to continue fire while a part is changing position.

Its fire is concentrated upon the part of the enemy's line to be assaulted.

As the above excerpt from the 1877 regulations shows, only rules for the cooperation of the artillery with the other arms in battle were given. The requirements for cooperation with infantry were only those given in the instructions for attack and defense; in the first, to assist the infantry advance or make it possible, in the second to relieve it as much as possible.

The commission which prepared the regulations of 1889 deserves greatest praise for the manner in which they prepared the fourth part of the regulations curtly denominated "Combat," which was a comprehensive exposition of battle tactics. Its basic principles formed a framework which survived the changes of years and which adapted itself to the later improvements and discoveries.

The relation between the supreme commander and the artillery commander which had remained loosely defined was later made definite. The commanding officer was required to assign a definite task to the artillery. Up to this time it had been customary for the commanding officer to give general directions to his artillery, relieving himself of the greater part of the responsibility, and allowing to the latter too great latitude. From the appearance of these regulations the leader was required to carefully consider the problem confronting his artillery, and was therefore compelled to familiarize himself with its capabilities. He must assign specific tasks to it as he does to his infantry and in that way he directs their efforts toward a common object. This great step forward was the result of the placing of the artillery permanently in divisions, which greatly further the mutual understanding among the three arms. The artillery commander is not hampered in the solving of the problem given him, but in order to fully follow out the intentions of the commanding officer he should as far as is consistent with the proper supervision of his arm remain in close touch with him. When conditions require him to be away, he should remain in communication by means of an officer.

Support of infantry by artillery was required by the regulations of 1877 and 1889, but only in general terms. The extraordinary efforts and losses which the Japanese infantry would have been required to sustain had they not been so powerfully supported by their artillery emphasized the knowledge that, aside from increased fire efficiency, results can be expected only from a thorough co-

operation of the two arms. The regulations of 1907 not only emphasized this principle, but gave the foundation methods for its development in training in time of peace.

In this spirit, and to eliminate all doubt as to their common relation, the regulations of 1907 stated that the infantry and artillery to whom was given a certain problem should combine on it, and that this could be done only by the artillery's placing its full power at the disposal of the infantry. Hence it is the duty of the artillery to maintain a lasting connection with the infantry, and to attack those targets which are most dangerous to the sister arm. As a rule, the hostile artillery will be the target first chosen, and it will not be until the opposing infantry lines have come in close contact that the necessity for attacking the latter will assume first importance.

While earlier teachings were based on the assumption that results could be expected only after fire superiority had been established over the hostile artillery and that after this had been attained an attack could be pushed home only by the holding down of the fire of that artillery; the aim now is to endeavor to free the mass of the artillery for fire against the hostile infantry. This is the main target as soon as our attacking infantry enters the zone of rifle fire, and an increasing effect must be made upon it as the assailants advance. Only so much of the artillery as can be spared from this duty holds down the fire of the hostile batteries which are working against our advancing infantry, and they are permitted to reply to fire directed upon themselves only in so far as it can be done without weakening the support of the infantry.

The assisting of the charge up to closest ranges by the fire of single batteries first required by the regulations of 1899, is now established as a principle, and in order to guard against losses in our troops due to this fire the infantry when it reaches the spot from which the final attack is to be delivered signals to its artillery, as observation cannot be depended upon.

In order to support the exhausted infantry which has just captured a position, and secure it against counter attack, a part of the artillery must be quickly pushed forward while the remainder attacks the retiring defender and pursues him with its fire to the extreme limit of its range. If the attack fails, the artillery must cover the retreat of the infantry.

Instructions for team work of the defense have undergone few

changes. During the opening artillery duel, hostile advancing infantry should be attacked at once. Its attack during the engagement is the main thing, and the opposing batteries are to be engaged when it is advisable.

As long as exposed positions were the order, and covered ones the exception, the demand for definite reconnaissance of targets was not imperative, and positions could be simply designated and occupied without much preliminary other than was required by secrecy. The necessity for accurate reconnaissance has been the great problem of the battery commander since 1893.

Since the adoption of the shrapnel with its effective depth, great precautions are necessary in the manner of occupying positions, and the use of cover has gained an importance which has tended to make the location of targets more and more difficult.

The necessity for accurate information has been the great problem that the artillery commander has been required to solve since 1893. Since 1899 this has led to the development of a system in which all the arms, including also the airships and the observation wagons, are used to develop and locate the points to be attacked. Timely and accurate reconnaissance is a necessary preparation for accurate results, and the time necessary to accomplish it must be allowed for. If the assailant has not been able to locate the enemy definitely, for example, the positions of his artillery, single batteries may be brought in position and fire opened to draw the fire of the enemy's batteries if possible and lead him to expose himself, as was done by the Japanese in the war of 1904. On the other hand, the defender must endeavor to locate the route of advance and the positions of the hostile artillery in order to surprise it by an overwhelming burst of fire. Further, the cleaning up of the situation should bring out information enabling the movements to be made as smoothly and as rapidly as the tactical situation and the conditions of the terrain permit. It is the duty of all troops to supplement the information gained in reconnaissance by timely reports.

While the 1889 regulations established the principle that it is in most cases of importance to bring superior masses of artillery into action as early as possible, those of 1907 changed this to the placing of masses in positions in readiness. Their introduction into the fight must await the clearing up of the situation. If a decisive combat is developed, a quick and certain decision is best reached by

the sudden development of the fire of a superior number of guns. Some of this artillery may be assigned to the duty of further developing the enemy's positions, while other parts attack carelessly exposed troops, cover dead spaces, etc. Batteries not brought into action at once either take up covered positions and prepare to open a surprise fire, at an instant's notice, or take up a position in readiness, according to the possible exigencies of the situation and the accidents of the terrain. The reserve designated by the commander takes position according to his orders. It should at the very latest be brought into action when the direction of the decisive attack has been determined. The employment of the artillery in regimental and battalion units is retained.

The experiences of the Japanese in 1904-05 are reflected in the 1907 regulations. Group formations are preferred to those in long lines, as they make it more difficult for the enemy to locate and range on them, permit extensive fire on our part, simplifies our problems of observation and fire control, and permits of a better use of the accidents of the ground.

Improvements in the handling of indirect fire has given the great advantage of our guns being able to open and continue fire from concealed positions, while the enemy's problem of locating and ranging and determining the strength of our artillery has been made much more difficult. But on the other hand, this kind of fire has the disadvantage of requiring most careful preparation on our part, and diminishes our command of the foreground.

It is essential that under all conditions the battery commander direct the fire of his battery from a position commanding a good view of the foreground. The observation wagons and telephone systems are arranged to afford him opportunity for this and at the same time control the fire of his battery under all conditions. This apparatus is also supplied for the use of the battalion commander.

Exposed positions permit of a quick opening up of fire for effect, simplifying the attack of rapidly moving targets, but they render the changing of position and the replenishing of ammunition difficult. The choice of the method to be employed depends upon the object of the engagement. The regulation states positively that fire will most often be delivered from exposed positions when the object is to assist in the decision of the infantry combat. It is understood that in the exposed positions all possible cover will be utilized. When the accuracy and effect possible with modern guns

is considered, it is readily seen that the position and efficiency of the hostile artillery will determine whether or not the guns will be able to maintain themselves in an exposed position. In taking up positions a well adapted combination of prudence, dexterity and speed is required.

Since the introduction of heavy artillery on the battle field, it shares with the field artillery the conduct of the attack on the hostile guns. The effect to be expected depends upon the position of the latter. If visible, the hostile artillery should be quickly destroyed or its efficiency greatly reduced; if difficult of location results can be expected only at the expense of considerable time and ammunition. The new guns, especially the field howitzer, can produce decisive results against targets which are difficult of attack on account of their protected location. Great importance is attached to the attack of hostile observation points. If it be possible only to render observation difficult from such points by bursting shell around them, the efficiency of the hostile artillery will thereby be greatly reduced.

Many of the principles of combat tactics expressed in the regulations of 1889 have retained their value up to the present. According to them, the fire distribution should be so regulated that no part of the hostile line can fire unmolested, at the same time care must be taken that there be no frittering away of effect due to too great dispersion. A numerical superiority of guns should be utilized by coordination, a combination of flank and frontal fire usually promising the greatest results. Even numerical inferiority can be overcome to a certain extent and effective results be obtained in spite of it by concentrating the fire upon parts of the hostile line.

The attack of machine guns whose importance has been greatly enhanced as the result of the experiences of the Japanese and Boer wars, should be undertaken immediately upon their appearance and before they have opportunity for firing upon the infantry. Airships and balloons should also be attacked as soon as they appear.

Distinction between the employment of the field howitzer and the field gun was made in regulations shortly after the introduction of the former in 1899. The latter can be used with slight effect against well-covered targets, the former are designed for attack of entrenched positions, guns protected by shields, towns, troops in woods, and airships at great elevations.

The increased rate of fire possible with the latter guns rendered

it evident that a greater expenditure of ammunition must be provided for. The equipment was increased, provision was made for bringing a larger quantity up to the firing line and to convenient positions as close as possible to it, and the artillery commander strictly enjoined to enforce economy in its use. Up to 1899 it was considered sufficient provision to have the contents of the caissons kept close in rear of the position and to take only the first rounds from the limbers before sending them to the rear. Now, however, the caissons are retained unlimbered at the side of the guns and the limbers taken as well.

The statement that every change of position interferes with the effectiveness of the fire must be admitted true, but if the situation demands, such changes must be made. The regulations of 1907 state that these changes must be so timed that the infantry will not lack the support of the artillery in critical situations. The instructions for the procedure in attack retain their offensive character. Considerations of effective fire made it advisable that the artillery take up their initial position as close as possible to the enemy. Greater results can be obtained from a surprise fire, and every effort should be made to attain it. The artillery attack in a rencontre fight, which is dealt with in the 1899 regulations without much reference to the infantry, is now coordinated with that of the latter arm. The opening of the artillery combat takes place simultaneously with that of the infantry or may precede it if its support is necessary to assist in the proper deployment of the latter arm or to support its advance.

The prospects are bright for pushing home an attack against an enemy committed to the defense if it be possible to hold down the fire of his artillery. The task is a difficult one against artillery under cover which does not expose itself by smoke or dust, and whose personnel is protected by shields against the burst of shrapnel. This task demands an extended and exact reconnaissance, a definite assignment of tasks, and a well-adapted disposition of the forces. The infantry must assist in the clearing up of the situation for the artillery by advancing and forcing the enemy to show himself.

As darkness favors the advance on a position, artillery must be trained in the taking up of night positions which have been selected in the daytime and be ready to open fire at daybreak.

The great value placed upon field fortifications since the Russo-

Turkish War has given rise to observations as to the best methods of attacking such defenses. In reconnoitering such a position it is necessary to discover the situation and class of the work with sufficient accuracy to enable the artillery commander to decide upon the kind of fire which promises the greatest effect. He must determine whether or not the howitzers should attack the stronger defensive points or the point to be assaulted, the location of his artillery positions and the lines of approach to them and he must occupy the latter as soon as the advanced posts of the enemy have been driven back. The occupation takes place usually at night under cover of the advanced troops and its success depends upon great caution. Fire should be opened up from them at daybreak. The first line will endeavor to silence the enemy's artillery, in which effort the howitzers play an important part. The personnel sheltered in the work is attacked by shell fire from the guns and howitzers. The hostile machine guns must be searched out and destroyed. The attacking infantry takes up its position in readiness for the assault under cover of night. A few batteries are usually sent forward with it and intrenched as close as possible to the work. Covered by the fire of all the infantry and the artillery obstacles are removed and the heaviest possible fire directed upon the defenders at the instant the attack is delivered.

For the defense of a field work the 1889 regulations prescribe a gradually increasing rate of fire from grouped positions for the artillery in order to hold down that of the hostile guns. The greatest possible intensity of fire must be delivered at the assaulting infantry before it can reach the dead space immediately in front of the work. Cover plays an important part in the artillery defense. With indirect fire the enemy can be held at long ranges without the defender's exposing the location and strength of his batteries, and a superiority of artillery on the part of the assailant can be greatly nullified. However, if it becomes necessary to direct a decisive fire upon the target furnished by the attacking infantry, there must be no hesitation about giving up sheltered positions. The remaining principles given in the 1889 regulations still hold good, namely: the determining beforehand of important ranges, clearing the field of fire, providing of cover in several positions, and the placing of the batteries to attain the superiority in the artillery duel. When the infantry advances its assistance becomes the main object; and the hostile artillery is atacked only insofar as it is necessary without neglecting

the former object. Siege guns can better attack the hostile artillery, as they are not so well adapted to the attack of moving targets. The principle is retained that the artillery must be able to withdraw from a temporary superiority in the artillery duel to unite with the reserves in throwing back a hostile infantry attack which has penetrated the line. In this duty the artillery must be prepared to hold out to the last moment.

New principles were introduced in the 1907 regulations relative to defense against night attacks. These include determining by day the direction and ranges of points which the enemy must pass in his advance, sending out of officers' patrols to observe the enemy and keep in touch with the artillery commanders, and the instruction of the personnel in firing by the aid of searchlights.

The capabilitiy of the horse artillery in its mission of assisting the cavalry in clearing up the situation is very great. It can force the enemy to show his strength comparatively early in the engagement, compel him to deploy, assist the attack of its cavalry and thus greatly facilitate the movements of the latter, which is all-important at the beginning of a campaign. The commander is able to keep his troops in hand for further disposition and penetrate the hostile screen with a minimum of loss of time if his artillery is properly handled. In combat of cavalry against cavalry the principal object of the horse artillery is to cover the deployment and attack of its cavalry. It must therefore seek positions from which an effective fire can be delivered upon the hostile cavalry without much reference to the hostile artillery. The rapid development of these situations demands that the artillery commander make his own decisions without waiting for orders from his superior.

CONCLUSION.

The development before discussed has been due to a variety of causes and has progressed by fits and starts.

The gradual increase of the number of batteries since 1899 was necessary in order that our western neighbor might not become superior to us in that arm. In 1889 his artillery numbered four hundred and fifty-six field and twelve mountain batteries of six guns each as against four hundred and thirty-four batteries of ours counting the fifty-four batteries added in 1890. The reorganization of 1899 and the increases of 1911 and 1912 were needed to insure us

a superiority in number of guns. (Three thousand seven hundred and eighty-six as against two thousand five hundred and ninety-six French guns.)

Until 1899 the increases were but patchwork by which the newly established batteries and battalions were added to existing regiments without regard to uniformity of organization until the resulting lack of uniformity became impossible. Conditions favoring the working together of the artillery with the other arms did not develop until 1899. Even then a considerable handicap to the proper training of the combined arms was encountered by the artillery in the lack of sufficient draft animals in the batteries at peace strength. It was not until last year that the urgent necessity for supplying this deficiency was provided for. If previous to this we had suddenly become plunged in war with an enemy whose peace strength batteries were stronger we would have been at considerable disadvantage. However, it must be acknowledged that if it had not been for the great increase in the expense involved this improvement would have been made long since. When the prospective increase in the peace strength has been carried out the passing from peace to war strength will be possible with very little confusion.

Our matériel is at least equally as powerful as that of any of our prospective opponents. Superiority in the artillery fight will depend upon the handling of the guns. The training of the arm has progressed according to the demands of the time, and the great importance formerly attached to movements of no value on the battlefield has been negated. The system of fire instruction should have been better adapted to the Model 96 gun when the latter was adopted. The adoption of this gun demanded that the system be placed on an entirely new footing as was done by the French in their regulations in 1901. Instead of attempting to secure the greatest effect possible with the minimum expenditure of ammunition these regulations required the attaining of the greatest possible effect in the least time. The fire regulations of 1907 did not come up to expectations and it was not until January, 1911—four years later—that the system was brought up to date.

The sound principles given in the 1889 regulations on the handling of field artillery in combat could with but slight additions and alterations be retained until the experiences of the Japanese war and the introduction of the rapid fire gun came to wield their powerful influence for change in the tactics not only of the artillery but upon the

infantry as well and more especially upon the action of the two arms combined. The new views upon this are brought out in the regulations of 1907.

The above review shows that we have not always maintained ourselves first in matters of organization, equipment and instruction among the powers. As the latter are constantly striving to pass one another in the struggle for war preparedness and efficiency, it is hardly possible for any power to hold long a position in the lead in those matters. When the changes now in contemplation have been made, however, our field artillery may be counted upon as being thoroughly equipped and instructed to meet the problems which will fall to its lot in active service.

II. FOOT ARTILLERY.

By Major General Schwierz, Z. D.

Translated by First Lieutenant C. Stokymar Bendel, Infantry. From Artilleristische Montashefte, June, 1913.

On April 1st, 1887, the separation of the German Field and Foot Artillery was carried out in accordance with the prescribed orders, in that a general inspection department for the Foot Artillery came into existence as the highest authority for that arm. This separation became for the Foot Artillery of greater importance as just at this time an important epoch in the history of the Artillery commenced with the invention of the smokeless powder and the general introduction of high explosives for the projectiles. So the Foot Artillery which had become independent could immediately devote itself to these important matters and the new demands which were required of it.

Organization.

The foot artillery was in the year 1888 under the general inspection department, organized into four inspection departments, which pertained to the old brigades. They composed the Prussian Garde regiments, 1 to 8, 10 and 11; the Prussian battalions 9 and 14; an instruction company; the Saxon regiment 12; the Winterberg battalion 13, and two Bavarian regiments; a total of 31 battalions.

The arm had not in the previous year been increased to the same extent as the infantry and the field artillery and therefore was con-

siderably behind these two as far as strength was concerned. Already at that time it was difficult for it, on account of its small peace strength, to fulfill the demands which would fall upon it in time of war. Still less would the present peace organizations be sufficient. The conviction gradually seaped through, at the end of the eighties, that in the future the field army could not get along without heavy cannons.

The strong fortified line on the French east frontier and the long fortified line in Western-Russia were the cause which led to the organization of special artillery siege trains. They were composed of heavy 12 centimeter cannons, short 15 centimeter cannons and 21 centimeter mortars. Little had been done for the quick mobilization of these siege trains. Teams were to be taken from the stables of the fortresses.

The further building up of the fortress line and the possibility there to find the enemy's field army in numerous strong entrenchments, made, therefore, a quick use of the attacking material imperative.

Then in 1890 the special siege-artillery trains for the mobilization were provided with draught animals. The organization received the name: "Foot Artillery with Draught Animals."

This organization at first had the drawback, that the troop had no practice in handling batteries with their teams and that the pieces as fortress guns were poorly suited in active campaign.

To give the troop some training, yearly attacking drills were held with all arms bringing in foot artillery with their teams. The difficulty encountered for this arm was that the teams as well as their drivers were hired for the use of the batteries.

First by giving heavy draught horses to single train battalions, from which sprang the present transportation detachments, an improvement took place. But during the first years the small number of the transportation detachments was insufficient and it was necessary to fall back again upon hired horses. In course of this time the troop learned how to pick out the really useful horses from amongst the hired ones, how in the shortest time to hitch them up with the harness which was found at the artillery depots and then to drive them—a good practice for mobilization.

The unsuitably constructed gun carriages were replaced during the next years by lighter and more easily driven ones, so the short 15 centimeter cannon by the 15 centimeter mortar, later by the long 15 centimeter mortar and these again by the 15 centimeter howitzer.

The organizing of the foot artillery with draught animals had placed before this arm new tasks. To accomplish the new problems during the war in the field and at the same time the old ones during investments and against fortified positions, the foot artillery then at hand was again found insufficient. The law of August 3, 1893, prescribed the strength of the foot artillery as 37 battalions with 149 cannons.

The Fifth and Sixth Inspection Departments, regimental staffs for the Ninth, Fourteenth and Fifteenth Regiments, five Prussian battalions, II/9, II/14, II/15, III/2, one Saxon company, one Bavarian battalion, III/2 and one instruction company were newly organized.

The Wurtemberg battalion No. 13 was changed into a Prussian one. In course of time the omission of the intermediate department of the inspection department with the division commander made itself felt. This measure of creating of the general inspection department was due more to economic reasons. Therefore in the year 1895, the division in two inspection departments which existed before 1887 were re-established. Here again for economic reasons—grades of two brigadiers were discontinued; this was a drawback in so far that the brigade commanders were much overtaxed by the assignment of four regiments each.

The foot artillery with its teams made in the next few years further advancement on account of the experience gained from the attacking maneuver. Special advantage for its training was the increase and further progress of the division of the draught animals. In 1891 six lance corporals, sixteen privates and forty-four draught horses were added to the two train-battalions. In 1895 such detachments were introduced by two more train-battalions, and a larger personnel was fixed. For the four considered train-battalions, the composition of the trains was increased by two first lieutenants, ten noncommissioned officers, two musicians, eighty-six privates, fourteen riding horses, eighty-eight draught horses. Therewith complete detachments were created. These were increased by two more in 1897, and again in 1900. There were in the latter year draught animals for the 3rd, 4th, 6th, 8th, 15th, 16th, 17th and 25th Train Battalions.

The efforts of the foot artillery with these draught animals, which received in the meantime the name "Heavy Artillery of the Field Army," were crowned in the year 1900 by an attack exercise with

sharpshooting on the maneuver grounds at Münster in the presence of His Majesty, the Emperor.

The praise of the Emperor as the highest officer of the army was to the effect that the foot artillery had shown its usefulness, and was up to such a standard that it was fully capable to be made part of the field troops. In recognition of this the 15-centimeter howitzer of the heavy artillery of the field army received the name "Heavy Field Howitzer."

During the summer of this year when the East Asiatic Expeditionary Corps was sent to China, it was accompanied by one battalion heavy field howitzer, of two batteries each.

On September 19 and 20, 1900, a heavy field howitzer battery, just arrived a few days before, took an important part during the action against the Peitang Forts, in that it by its fire greatly assisted the charge against the forts, which were strongly protected by mines as well as flooded land.

The further erection of land fortifications—especially the erection of numerous armored fortifications, during the end of the nineties—and the necessity of manning the armored batteries with efficient and highly trained troops, led at the beginning of the new century to a further increase of this arm. There was organized in 1901 the regimental staff and the eleven battalions of the Thirteenth Foot Artillery Regiment, 1902 six companies—half battalions without commander—by the First, Eighth and Eleventh Regiments, 1903, four companies—same half battalions—by the Ninth and Thirteenth regiments. The establishment of the half battalions, which were later placed under charge of a staff officer for training, but who was not the commander and had no staff under him, proved to be in a short while impracticable.

Therefore in 1906 the half battalions of the Eighth, Ninth and Thirteenth regiments and of the two newly formed companies became third battalions of the Eighth and Thirteenth regiments. Two half battalions still remained.

The foot artillery was composed in 1906 of eighteen regiments with forty battalions, a total of one hundred and sixty-five companies—from 1908 called "Batteries."

Also the organization of the teamster detachment had been changed. Those in 1900 consisting of eight teamster detachments were in 1902 attached to the following foot artillery regiments according to the law, namely the 3rd, 4th, 6th, 7th, 8th, 10th, 15th,

Garde regiments. In the year 1904 they became part of these regiments and received their uniforms. The enlarging at the same time by four noncommissioned officers, nineteen privates, four riding horses and sixteen heavy draught horses in the composition of the teamster detachment resulted now in the foot artillery. After newly organizing a teamster detachment by the Twelfth regiment, one by the First Bavarian Foot Artillery regiment (1904), one by the Foot Artillery Shooting School (1905) and three more teamster detachments (1906) there were in the last years one teamster detachment in each of the 3rd, 4th, 5th, 7th, 8th, 10th, 11th, 12th, 14th, and 15th Garde Regiments, 1st, and 2nd Bavarian Regiments and in the Shooting School. The composition of the detachments was (1904) increased by three noncommissioned officers, twenty privates, four riding horses, and sixteen heavy draught horses. They had then sixty heavy draught horses.

Just as with the land fortifications so also it had proved necessary to increase and strengthen the coast defenses. In 1888 the foot artillery had to garrison the coast defence at Danzig and Swinemunde with the Second Regiment after the fortifications of Memel had been given up. In 1892 a company of that regiment was sent to Pillau. From the first of October, 1893, on the Third Battalion of the Second Regiment which was in Pillau was designated for the coast defenses of that place.

The rest of the coast defenses of the empire by Kiel, on the Kaiser Wilhelm Canal, at the mouth of the Elbe and Weser rivers, the Jahde and on Helgoland were for some time in the hands of the navy. The North Sea fortifications protected the naval ports and the coast of the mainland; these could, however, prevent a hostile fleet using the Frisien Islands as a base for future operations just as little as the outlying Helgoland. This it could do by occupying them with ease. An enemy would find there a good opportunity to establish a coaling station and to make repairs, so that his fleet would always remain complete before the German coast. In the new century, as one saw this danger and that a collision with England was not impossible, measures were taken for defending the Frisien Islands. These measures at first only provisional, were not sufficient, and so steps were taken for fortifying them with coast batteries. After the erection of the defenses were completed on the Island Borkum in 1909, three batteries of foot artillery of the

Second Regiment were sent there and they held target practice there that same year.

The great distance from Pillau to Morkum made the district too large for a single regiment. Therefore in 1911 the Second Foot Artillery Regiment with its twelve batteries took charge of Swinemunde and Borkum, the new Seventeenth Regiment, Pillau and Danzig. Each place was garrisoned by one battalion. During the increase of 1912 the Second Regiment was increased by one battery which was assigned to the Second Battalion at Emden (Borkum).

The new organizations which were created during the first ten years of the new century were mainly for the garrisoning of the new defenses. The foot artillery had not held its pace with the forming of the new army corps. So it came about that at the maneuvers in some army corps no heavy artillery could assist, in others it was necessary to attach some from other army corps. A good training for the troops for the war is, however, only to be expected when the same battalion is always attached to the same army corps in the maneuvers that it would be in case of war. This is the case, of course, with all other branches of the service. As therefore in 1912 a further organization of new army corps took place, it was found necessary also to increase the foot artillery. Another ground for the organization of new regiments was that, within the last ten years, quite a strengthening of the French fortifications had taken place. Complete reconstruction of a large number of forts changed the ramparts into regular blocks of concrete, the construction of a large number of armored turrets, especially along the frontier forts, and of rapid fire armored turrets and armored shields formed further a great artillery strengthening. Under these conditions it was necessary to have considerable stronger siege artillery for the reduction of these fortifications. The material at hand for the foot artillery with the other tasks of it was not sufficient any longer.

Therefore on October 1, 1912, one inspection department and two brigade staffs as well as several regiments were organized. The 3rd battalions of the Eighth and Thirteenth regiments were united into the Sixteenth Regiment; by taking two batteries from each of the First and Eleventh Regiments, the Twentieth Regiment composed of two battalions was created. With that the two still remaining half battalions were done away with. Further the Eigh-

teenth Regiment was organized and the Nineteenth Saxon Regiment and the Third Bavarian Foot Artillery were formed. All regiments, so far as they did not have a teamster detachment, with the exception of the Second and Seventeenth Coast Regiments, received each one teamster detachment. The composition of the detachment was composed in 1908 each of one officer, fifty-seven noncommissioned officers and privates, eighty-eight horses, of which sixty were heavy draught horses; in 1912 it was fixed at three officers, ninety-two enlisted men (including fourteen non-commissioned officers), one hundred and thirty-eight horses, of which ninety were heavy draught horses. On that account the composition of the battalions (excepting in the Second and Seventeenth Regiments) which formerly consisted of twenty officers, five hundred and seventy-six enlisted men, was decreased to twenty officers and four hundred and eighty-six enlisted men. The horses of the teamster detachments, which ever since 1907 had been yearly increased by two riding and six draught horses, were from 1913 on entirely remounted. The German Foot Artillery consists now of twenty-three regiments, all of two battalions each, thereof twenty-one with teamster detachments the independent Nineteenth Battalion with teamster detachment, as also the instruction battalion of the Foot Artillery Shooting School with two teamster detachments.

The development of the Foot Artillery Shooting School has been going on for the last twenty-five years. In 1888 an Artillery Shooting School was used jointly by the Field and Foot Artillery under one director. To it belonged one instruction battery of the field artillery and one instruction company of the foot artillery. On April 1st, 1890, the Shooting School for the foot artillery was provisionally established, with two instruction companies under the supervision of one director, who was subordinate to the commander of the Artillery Shooting School. Yet in the same year the final separation was carried through; the highest Cabinet Order of December 8th, 1890, determined the name, "Foot Artillery Shooting School" and provided that at its head should be a staff officer of the rank of regimental commander. The school was placed under the supervision of the general inspection department of the foot artillery. Through the increase of 1893, a third instruction company was organized and the three instruction companies with a battalion staff were turned into an instruction battalion. In the same year the shooting school was placed under the first inspection

department. In 1905 a fourth instruction company was organized for the instruction battalion and a teamster detachment for the schooting school. To show that the shooting school was an institution for the entire arm, and also to bring it into more prominence, it was again placed directly under the general inspection department. In 1912, the commander of the Foot Artillery Shooting School received the grade of a brigade commander. Further an instruction regiment was organized through the forming of a regimental staff, a second instruction battalion and a second teamster detachment. The higher Fire Control School and the examination commission for captains, first lieutenants of the foot artillery stood in 1888 under the general inspection department. The Higher Fire Control School was together with the shooting school under the first inspection department, under which it still is today. In order better to control the discipline, companies were organized in 1895. The examination commission for captains and first lieutenants was dissolved in 1895, on account of doing away with the examination of the last grade of the foot artillery officers.

The directors of the artillery depots of the unfortified towns were from 1897 on, as a rule, not supplied by officers of the foot artillery, and the withdrawn officers were assigned to the troops. From the beginning of the same year in the large fortresses in order to unburden the artillery officers of that place, it was arranged to have retired staff officers as directors of these artillery depots. The artillery depot inspection departments (later direction departments) which were over the artillery depots, were for some time under the foot artillery inspection departments and were placed also under the Master of Field Ordnance after the creation of that office.

Table 1 contains the composition of the foot artillery of 1888 and 1913.

THE ARMAMENT.

The foot artillery had in 1888 in the siege trains the following pieces: The heavy 12-centimeter, the 15-centimeter ring, the short 15-centimeter cannon, the 15-centimeter and the 21-centimeter mortar. In the fortresses were found besides the ones already mentioned 3.7-centimeter revolving cannon, a large number of 8 and 9 centimeter cannon—constructions from the years 1861, 1864, 1867, 1875, 1879—older 12-centimeter and 15-centimeter, short 21-centimeter cannon, 9-centimeter mortars and a few taken over from the

coast artillery—long 15-centimeter ring cannon and 21-centimeter jacketed cannon on fixed platforms. On the coast were long 15-centimeter and 21-centimeter ring cannon in permanent works, heavy 12-centimeter, heavy 12-centimeter cannon, 15-centimeter mortars and 21-centimeter mortars in armored batteries.

The cannons fired shells filled with powder and shrapnel, the 8 and 9-centimeter cannon also grape, the revolving cannon shell and grape, for the 9 and 15-centimeter mortars shrapnel were introduced since 1884, besides the 9-centimeter mortars fired shells with a high explosive, the 15-centimeter mortars fired shells filled with powder and shells with gun-cotton; the 21-centimeter mortar fired shells as did also the 15-centimeter mortar.

Until the middle of the eighties the heavy 12-centimeter cannon of hard bronze was considered as the main piece used for demolitions. Destruction of demolition presented, however, all kinds of difficulties which in the course of time on account of the changing of bore still more increased itself. The greatest distance for demolitions was fifteen hundred meters. Since the introduction of the 15-centimeter mortar in 1885, its importance as main piece retrogated, but still it remained of importance for its long range shrapnel fire which was quite considerable for that time. In place of the 15-centimeter ring cannon, which originated from the year 1872, a new construction was proposed.

The short centimeter cannon, which was of great value in the war of 1870-71, was still a useful piece for piercing coverings as well as walls. The 15-centimeter mortar was in consequence of its lightness and its use in a great number of ways, a very useful gun for the artillery duel, especially with gun cotton shells against cover. Its shrapnel fire was able to hit cannoneers behind breastworks. Its range was however only three thousand, two hundred and fifty meters, with gun-cotton shells only two thousand, five hundred meters.

The 21-centimeter mortar was a very effective gun against batteries, especially their covering; and a demolishing effect upon permanent fortifications was produced by firing gun-cotton shells. Its range was three thousand, nine hundred meters.

Of the fortress guns, the revolving cannon, the 8 and 9-centimeter cannons, were used for flanking the ditches, the 9-centimeter cannon on a high carriage was used to repel charges on the wall of the fort.

The short 21-centimeter cannon was a useful piece to demolish covering and masonry constructions in permanent fortifications.

The 9-centimeter mortar did not have a sufficient effective fire and only a range of one thousand, seven hundred meters.

The guns of the coast artillery were inferior as compared to those on the ships, the range of the mortar was entirely too short.

In the year 1888 efforts were made to increase the range of the mortar. The short range of the sea coast mortars was of special concern. By doing away with the front guiding and by increasing the powder chamber and introducing large charges of slower burning powder, it was made possible to increase the range of the 21-centimeter by over two thousand meters; that of the 15-centimeter by over seven hundred meters.

In 1888 after the introduction of smokeless powder (a gun-cotton powder in the form of small leaves) by the field guns, efforts were made for the introduction of this powder for the guns of the foot artillery. From the results of these experiments, the powder leaves—the coarse leaves of the 15-centimeter ring cannon—were introduced. By some of the guns the powder leaves were found to give the desired results. Therefore experiments wre tried with nitroglycerine powder manufactured by Nobel. This powder was made in particles of various sizes which were pressed into cubes, and on that account called cube powder. It was more staple than the leaf powder by the short cannon and mortars as well as by the light quick fire, the grape, and the 8 and 9-centimeter cannons. It was therefore introduced by these types of guns.

The new powder was much more effective, and different in burning and in gas expansion qualities than the black powder. By using longer projectiles the hitting ability was improved; this, however, required more severe rifling, which gradually increased in severity. For the gun construction the necessity presented itself to have a strong guide band at the back end of the gun. Bronze proved not to have sufficient resisting power for the new powder. Therefore steel for gun barrels had to be resorted to or the bronze barrels were supplied with steel linings. The latter should also make the gun withstand explosions that might occur in the barrel. The results of the many experiments made with the new powder led in 1892 to the introduction of new guns.

The long 15-centimeter cannon replaced the 15-centimeter ring cannon in the Siege Artillery. The attempt at reconstruction of the

15-centimeter cannon began already in 1883 and resulted in the heavy 15-centimeter cannon of 1889. At that time the introduction of the new powder gave new grounds for its discontinuance.

The long 15-centimeter cannon had a steel jacketed ring barrel and was in the rifled part seven calibers longer than the 15-centimeter ring cannon. The carriage received a ratcheted sighting mechanism. The gun was heavier than the 15-centimeter ring cannon, and the range was greater by two thousand, five hundred meters. It fired bombshells and very effective steel delayed action shrapnel. The strong recoil made a glycerine brake a necessity, which is fastened to the gun platform. On the march the barrel was transported in a gun wagon of light weight.

The long 15-centimeter mortar replaced the 15-centimeter mortar which had proved itself of little use for the new powder. By lengthening the barrel to seven and one-half calibers in the rifled part, the gun did not become too heavy for the service. The gun band of bronze had a steel lining and rotating breech mechanism. The carriage of the 15-centimeter mortar was generally retained, but with a ratchet sighting mechanism. The increase of range by about one hundred and twenty meters was important.

The 21-centimeter mortar with steel lining has a barrel with a steel lining which was equipped with a new arrangement of the bore so as to be more suitable for the new powder. Rather favorable burning conditions were thus obtained and an increase of range. The gun was provided with a new carriage made of iron.

The heavy 12-centimeter and the heavy 15-centimeter cannon received steel linings without changing the interior barrel construction.

In 1890 an effective 5-centimeter cannon was added to the 3.7-centimeter revolving cannon to assist in flanking the ditches, which also behind armored shields assisted the infantry defense by being placed in the trenches. It was also used for a time with the Siege Artillery.

In the first half of the nineties the following were eliminated: the 9-centimeter mortar on account of too short a range and the small effective fire; the 15-centimeter mortar, on account of being replaced by the long 15-centimeter mortar in the Siege and Coast Artillery; the short 21-centimeter cannon was replaced by the 21-centimeter mortar with the steel lining, because the latter could solve all the problems of the former during investments of fortresses. The

gun barrels of the short 21-centimeter cannon were used by the Fortress Artillery as the turret howitzers.

The long 21-centimeter mortar was, so to speak, a helping-out gun. Its gun carriage proved itself not quite equal to the strain which was brought upon it while firing. It was also used by the Foot Artillery with draught animals. It was not especially suited in the field because the wheels used on the march on the gun carriage had to be taken off, and replaced by another pair prior to firing. To do away with the excessive recoil wedges were also tried. The defects of the long 15-centimeter mortar were corrected with the appearance of the 15-centimeter howitzer of 1893. It had a suitable weight—when limbered the piece weighed two thousand, six hundred and fifty kilograms. This extraordinary suitable gun had a steel jacketed gun barrel with a wedge-shaped breech block, a short gun carriage with wheels made of steel with ratchet arc, a small gun platform with hydraulic recoil brake. Later on the gun platform for field use was done away with and woven wicker mats were laid under the wheels and the trail. The brake of the piece was also used as the recoil brake. The range of the 15-centimeter howitzer was greater by fifteen hundred meters over that of the 15-centimeter mortar. The gun fired bombshells with a double fuse and the long shells weighed forty kilograms, with percussion fuses. The 15-centimeter howitzer replaced at first the long 15-centimeter mortar by the Foot Artillery with draught animals, later the same by the Siege Artillery and the Coast Artillery. The howitzer was also found of use in the armored turrets by the Fortress Artillery.

The use of high explosives as a charge for projectiles had just as marked an effect upon the development of the Artillery as the introduction of smokeless powder. In 1888 already for some time there had been introduced shells charged with gun cotton by the fifteen and twenty-one centimeter mortars. The gun cotton, however, proved to be unstaple, although great care was used in storing and in handling. Therefore of great importance was the introduction in 1888 of picrine acid, known as shell charge 88, as an explosive. The charge of this explosive was at first of a loose crystal-like form which was put in the old castiron shells. The shell was caused to burst into many pieces, many of which were too small to be effective. By using a better suited iron and especially steel, effective small bursting parts were obtained. The shells were constructed with a

head which could be unscrewed, so that melted charges of greater weight in cardboard cases could be put in. The shells received in 1889 the combination fuse, later upon the improvement of the percussion element, firing with time fuses by the shells was given up.

The introduction of bombshells gave good effect against living targets behind covering, therefore in the middle of the nineties the shrapnel fire could be omitted by the short cannons and mortars. This was also desired for other reasons, for the hitting with shrapnel from mortars often presented difficulties and the effect was often neutralized when the fuse setting and the time of flight did not correspond.

The former combination fuse required that the igniting screw be kept separate during transport. This igniting screw was screwed in just before firing the shot. The desire to have a ready for use fuse had been demanded for some time. Through experiments which lasted from 1888 to 1892, the combination ready for use fuse was introduced. The complete fuse is on the projectile and is made ready for use through pulling out of a projecting pin. A similar ready for use fuse for shells was introduced with the 1896 shell fuse.

In the beginning of the new century a substitute for the twelve centimeter cannon was found necessary. The gun at the time it was furnished with the steel-lined bore received no alteration with respect to the bore. By the replacement of the 15 centimeter ring cannon the same caliber had been kept at that time. The long 15 centimeter cannon was nevertheless quite serviceable, but had become too heavy. Therefore, the caliber was reduced in constructing the new heavy 12 centimeter cannon. The gun band and projectile could be made longer and a large charge could be used. On that account a greater muzzle velocity and increased efficiency from the powder was obtained, besides a greater effective zone.

In 1901 the 10.5 centimeter cannon was constructed. It had a 10.5 centimeter caliber, a wedge-shaped breech block, glycerine recoil brakes fastened to the platform, great accuracy and a shell range of over 10 kilometers, shrapnel range of about 8.5 kilometers. It fired shell and shrapnel weighing 18 kilograms, about as heavy as the 12 centimeter projectiles. The 10 centimeter projectiles and its case are assembled into one cartridge. In fortresses the 10 centimeter cannon is also used in armored turrets with shielded gun carriages. The shields of the gun carriage are arched loop-holed steel shields and are similar to those used by the rapid fire guns of the naval vessels. The guns stand on concrete gun platforms.

As a gun to repulse charges the 6 centimeter cannon was introduced in the turnable and raiseable armored turrets. The use of the 9 centimeter transportable cannon could not be relied upon any longer because of the damage that would be done by shell fire to the rampart communications.

In place of the 21 centimeter mortar a better constructed 21 centimeter mortar of steel came into use. The gun is lighter and on the march the gun barrel is carried in a wagon of light construction similar to the one which is used to transport the long 15 centimeter gun. The range is about 8000 meters greater than that of the 21 centimeter bronze mortar. The gun could be used in the heavy artillery of the field army.

The introduction of the French recoil cylinder gun brought the question of rapid fire guns of large caliber to the front. Before everything came the consideration of the replacement of the principal gun of the heavy artillery of the field army. The 15 centimeter howitzer (heavy field howitzer) was not originally constructed without a gun platform. It therefore appeared on account of the short gun carriage that an improvement in respect to mobility could be made. The use of a metallic cartridge case as well as the enlargement of the effective zone by increasing the range were also desired. So in the first year of the new century the heavy howitzer of 1902 and, as an improvement of the older 10 centimeter cannon, the 10 centimeter cannon of 1904 was introduced.

The heavy field howitzer of 1902, with a gun barrel over 11 calibers long and Krupp breech mechanism with recocking device, had a gun barrel recoil arrangement consisting of hydraulic brake and return springs. The gun barrel without shield-studs runs back on a slideway of the cradle and is connected with the brake by an attachment. On the gun barrel is found a telescopic sight. The gun on account of its long gun carriage can easily be driven, but does not possess shields. During firing, wicker mats are placed under the wheels. The weight of firing gun is about 2000 kilograms. The gun fires a shell of 40 kilograms with percussion fuse. The assembled charge is placed in a metal case. The range is 7400 meters. In 1904 an improved shell with an improved fuse was introduced. The effect of the projectile is especially effective against artillery protected with shields; the effect of the exploded particles is mainly sideways and a trifle backwards.

The 10 centimeter cannon of 1904 deserves attention. The

former 10 centimeter cannon was fixed as a gun barrel recoil gun similar to the heavy field howitzer of 1902 but with two recoil brakes beside one another and with a return spring. It had a telescopic sight and was easily driven. On account of these improvements, its great range and good fire effect, it became an entirely modern gun for the siege artillery.

The observation and the ammunition wagon of the heavy artillery of the field army had up to this time been built in one part. At the same time as the field howitzer 1902, a new observation wagon of two parts was introduced, through which a better handling in driving was obtained and one wagon part could be used with horses to lay the cable. In 1909 the ammunition wagon of the field howitzer of two parts with armor plates was introduced for the heavy field howitzer. On this wagon nine men could be transported. When the gun was in firing position the cannoneers found cover behind the two ammunition wagons, which belonged to it.

In the mean time private industries had been able to construct gun barrel recoil guns of heavy caliber. These guns had longer barrels, greater effectiveness, and could be easily transported and at the same time the gun platform was not needed any longer. This latter advantage was accomplished through the use of the wheel belts.

The replacement of the long 15 centimeter cannon and the 21 centimeter mortar which were no longer up to date was a problem to be dealt with by the German foot artillery. The long 15 centimeter cannon was very heavy, especially during transportation, it had to be placed upon a special gun platform which had to be bolted together. The range was smaller than that of the 10 centimeter cannon. An increased range for the heavy caliber guns was very much desired, as the fortresses in course of time commanded an increased area; and the certainty was established that before the real fighting position was taken up, advanced positions would have to be reduced. The doing away with the gun platform was especially desired by the 21 centimeter mortar as it should follow the field army in reducing the fortress line.

The new gun complied with the mentioned requirements. The 15 centimeter caliber was abandoned for the same reason that the 12 centimeter caliber had been. The 13 centimeter cannon introduced in 1909 is constructed after the model of the 10 centimeter cannon of 1904, it has however a wedge-shaped breech mechanism, and a panoramic telescope. During transportation the gun barrel lies in

a gun barrel carriage, from which it can be pulled over to the gun carriage in a few minutes. Before leaving the solid road the wheel straps are attached to the wheels; during the firing the gun stands with wheel straps upon wicker mats, which replaces the gun platform. The gun fires shells with a percussion fuse, and shrapnel with a long carrying double fuse. The range is over 12 kilometers. Fire readiness and fire rapidity are considerable. The new mortar introduced in 1910 has a wedge-breech mechanism like the 13 centimeter cannon, and a telescopic sight with a drum. On the latter is a loading indicator, which is first moved according to the indicated charge, then the range or elevation is determined. By the use of an attached slide the gun can be given the proper elevation. To sight right and left the panoramic telescope is used. The telescope is also used for making corrections on account of the wheels not being on the same level. The gun carriage consists of an upper and a lower carriage with a long gun barrel recoil. The shield pegs are at the rear part of the gun barrel. In taking elevation the cradle is supported by a compensator. The gun barrel carriage and the wheel straps are similar to those of the 13 centimeter cannon. The gun fires also without a gun platform. The projectile is the 21 centimeter shell 1896, weight 119 kilograms. The composite charge is placed in a composite case.

The equipment of the foot artillery with small arms has also advanced with the times. In 1888 it was equipped with the hunting rifle (*Jagerbuchse*) model 71; in 1891 it received the carbine model 88, which was an improvised arrangement and was called "Rifle Model 91." In 1910 the equipment with the carbine model 98 followed.

At the end of the last twenty-five years the foot artillery has been fully equipped with modern guns and small arms.

A tabular statement of the principal guns is found in Table 2.

TRAINING REGULATIONS.

The drill regulations of February 22, 1883, for the foot artillery and the instruction for shooting of 1886 were in force in 1888.

The regulations of 1883 contained as uniform regulations, the service of a gun with smooth wedge breech mechanism in siege gun carriages, and the placing and fire directing of a battery. The deviations therefrom for other guns were given in a special appendix. Introduction of new guns made it necessary for a revision of the drill

regulations in 1891. In consideration of other newly introduced guns a new regulations was published in 1893. The service of the 15 centimeter howitzer formed the model, and was designated as the instruction gun. For the other guns the deviations in the service from the instruction gun are given. Moreover, one part contained the training of the battery. The 15 centimeter howitzer in its low wheeled gun carriage differed especially from the other guns, so the supervisions of the matériel suffered, which dealt with the other guns. In the new regulations of 1898 the service of the 15 centimeter howitzer, the 21 centimeter mortar, and the heavy 9 centimeter cannon were taken as the models for training for all the guns and thereby better orientation was aimed at. The development of the heavy artillery of the field army, however, at the beginning of the new century again required alterations. The regulations were divided into several parts. Part I, "Training on Foot," was given out first. Part II, "Training with the Gun," appeared in 1901. It contained the service by the heavy field howitzer, the 21 centimeter mortar and the 10 centimeter cannon each in a special section considered as model guns. The section about the 9 centimeter cannon served as a model for the service of the other guns with the exception of the 21 centimeter bronze mortar and the long 15 centimeter cannon. The service of these was appended to that of the 21 centimeter mortar, and that of the 15 centimeter howitzer with gun platforms. Special instructions were prescribed for the revolving cannon, the 5 and 6 centimeter rapid fire cannon, the turret howitzer and the 21 centimeter ring cannon. In 1900 Part III "The Heavy Artillery of the Field Army" appeared. This mentioned in detail the tactical use of the heavy artillery in a campaign and against a line of forts; and was replaced in 1906 by a revised edition. Part IV dealt with that part played in the attack and defense of fortresses by the Foot Artillery. In 1907 there appeared a new edition of Part I, "The Training Without the Gun," which took the place of that part of the 1891 regulations which dealt with "The Training on Foot." The drill regulations of the Foot Artillery approved by the A. K. O. of November 19, 1908, now prescribed, contained everything which had heretofore appeared in separate orders and in a few special instructions. The working together of the Field and Foot Artillery was a beneficial influence which brought about the agreement upon the fundamental principals for the two arms. The regulations contain the following parts: Part I, Training on Foot. Part II,

Training at the Gun. Here the heavy field howitzer 1902 is dealt with as single gun and as gun in the batteries. Part III, Training of Guns With Their Horses, thereunder separately dealt with, training in driving, drilling, the battery and battalion of the heavy field howitzer. The batteries and the battalion of the 21-centimeter mortar (later replaced by the new mortar), as well as remarks upon the contemplated use of the 10-centimeter cannon and the 15-centimeter cannon (later replaced by the 13-centimeter cannon). Part IV, the combat is divided into attack and defense. Here are meeting engagements, attack upon the enemy taking up the defense, upon an entrenched position, pursuit, attack upon a blockading position, and attack upon a fortress, defense in the field and of an entrenched position, retreat, and defense of a fortress. Part V, Parade; Receiving and Returning of the Color; Honorary Ceremonies; Appendix: Music, Signals.

In 1911 important changes were made in the regulation. The grounds were the application and the action of the entire artillery in the combat, and the working together of the different arms, and the assistance of the commander of the troops in the directing of the combat action of the artillery.

"The Instructions for Shooting of 1886" were divided into the following parts: Shooting with shells against stationary objectives in a campaign and against covered objectives with subdivisions; against guns in front; against fortress lines; against interior works as well as the indirect breaching and demolishing; shooting with shrapnel against covered and uncovered objectives. As something new, the following was added: Shooting with shrapnel from mortars and firing with reference to a map. In 1890 a new system was devised, and after many tests and revisions was adopted in 1892 as "Firing Regulations for the Foot Artillery." The regulation which should govern within the fire zone, hastened the combatting of the enemy's fire greatly on account of better handling of the battery, while heretofore the combating the fire went slower because the firing had to be done by piece on account of the various sizes of the powder chambers in the bronze cannons. The especially concise regulation contained "the preparation for firing," the fire, when exact observation is possible and when such is impossible, and further special fundamental principles for individual firing. The Instructions for Firing, which appeared in 1896, gave as

fundamental rule, that during a war all methods are correct which quickly and completely answer the purpose. The principal stress was laid more upon hitting and obtaining quick results than upon the method used. A more field-like mode of procedure was recommended, a correct estimate of the situation and reliable reconnaisance. An improvement was meant by the introduction of making corrections by battery for errors in deflection, and having a new chapter about the firing of several batteries. The regulations had reference to the new sighting and observation devices (sighting arc and telescope), as well as the devices to assist in reconnaisance and for the keeping in communication with the commanding officer's position (captive balloon, telephone and visual signal). A new scheme was gotten up in 1907, and essentially through the artillery order of November 19, 1908, it was adopted in the firing regulations for the Foot Artillery. It contains everything that pertains to shooting: Firing instruction, firing with guns, instructions for practice firing, training for gunners, and firing with small arms. The old regulations were discontinued. In the part "Firing With Guns" the instructions for reconnaisance, observation, and designation of objectives are given. In the firing of a battery the following are mentioned: Fork-firing followed up with effective fire; zone fire or firing according to a plan. Under special conduct of firing are mentioned: Moving targets, reconnaisance troops, aerial targets and armor. Later on the firing of the battalion and of larger bodies is dealt with, and the firing with shells is omitted. The regulations received in the last years an addition with respect to firing at airships. The troops have become very familiar with the regulations.

For the Coast Artillery special regulations are issued.

The regulations for the handling of the guns are: "The Regulations About the Service and Handling of Guns of 1891 and 1894," "The Handling of the Gun of 1898," and "The Handling of Material of 1910," now still in effect, were often materially amended, as is to be expected, due to the great variety in armament of the Foot Artillery. The former "Battery Construction Regulations," which originally only dealt with construction of cover during a fortress combat, are now replaced by several instructions for the battery construction, in consequence of the introduction of low gun carriages and the development of the heavy artillery. These

were replaced by "The Battery Cover Instructions of 1909," which took into consideration the modern guns, the construction of cover in a field campaign, and the stronger cover, and also considered the fundamental principals, "The Service of the Pioneer of All Arms in the Field."

INSTRUCTION.

Before 1888 the exercises of the Foot Artillery consisted of instructions in shooting and armament.

The shooting instructions on land consisted only in firing at targets in small frames, training for a fortress combat. Instruction was given in throwing up entrenchments and how to overcome obstacles. In the nineties targets were added similar to those met in a field campaign, especially entrenched positions, and tactical considerations stepped into the foreground. With the further development of the heavy artillery of the field army in the nineties, the greatest stress was laid upon combatting objectives as would appear in a field campaign, fought on a large scale, or in a line of forts. Besides firing on the target range, field firing was conducted during the last years. It is worth while mentioning that in 1910 guns were introduced which permitted firing over troops. This made the exercises more war-like. Combined exercises with the Field Artillery using direct fire could thereby be better conducted. The sea exercises in firing were always conducted near the garrisons of the Coast Artillery Battalions. Those at Swinemunde, on many occasions, in the presence of His Majesty the Emperor.

The armament exercises held during 1888 had as objective the armament of the fortresses. The conclusion reached was that the use of the heavy guns by the field army could not be dispensed with. From 1888 on the exercises on a larger scale with the co-operation of Foot Artillery with teams took place. From these were developed in the new century the attack exercises which are still in force. In these the attack against fortified positions with the co-operation of heavy artillery is carried out. The field and the heavy artillery used direct fire. Later exercises took place where direct fire was not used, and in many cases with a view for the corps maneuvers. In the new century battalions of heavy field howitzers took part regularly in the fall exercises of those army corps that had control over the Foot Artillery. The corps that

did not exercise authority over the Foot Artillery had heavy howitzer battalions assigned to it for the maneuvers. The assignment of foot artillery to all army corps has been ordered since 1912. Besides the Battalions taking part at the maneuvers since 1890, officers of the foot artillery have been ordered to take part at the maneuvers besides the battalions.

Of special importance for the familiarization for a common fire action of the field and foot artillery by some army corps, heavy field howitzer battalions took part at the brigade exercises of the field artillery within the last years.

Foot artillery in large numbers took part at the yearly fortress exercises.

INSTITUTIONS.

The Artillery and Engineer School had, in 1888, a lower and a higher course for the foot artillery. In these courses general and special military science was taught. That part of the school used in 1913 as the "Military Academy" was, in consequence of its many students and course followed, entirely too small. After numerous changes of the arrangement, the "Military Academy" was united with the Artillery and Engineer School, on October 1, 1907, into one institution.

The Shooting School.—In 1888 the instruction courses were conducted at the firing range "Tezel" by the Artillery Shooting School located at Berlin. Captains and 1st lieutenants, as well as noncommissioned officers were ordered there. In 1890 the Shooting School was transferred to Jüterbog, where the conditions were more favorable. In the same year the separation of the Field and Foot Artillery School took place. From 1892 on, besides the former course for officers, a four-weeks' information course was prescribed for staff officers. In 1894 the instruction at the Foot Artillery School was greatly enlarged. Besides the former course for officers, two new courses for officers on a furlough status and a course lasting two and one-half months for junior officers who had just left the Artillery School were to be conducted. From 1901 on, officers of the general staff attended the course for staff officers. From 1907 on, courses were established for aspirants to become officers of the furlough class, of which two for vice-sergeant-major, of four weeks, and one for the noncommissioned

officers of the reserve for six weeks, respectively. In order to further the knowledge for common combat action of the field artillery and foot artillery, from 1906, generals and staff officers of the foot artillery were ordered to attend the Field Artillery Shooting School, and from 1910 the divison commanders, field artillery brigade commanders and staff officers of the Field Artillery were ordered to the Foot Artillery School. In 1908 the course for aspirants to become officers of the furloughed class was increased to six weeks.

APPLICATION.

The function of the Foot Artillery in 1888, not considering the coast region, was that of siege or fortress artillery. At that time the tactical consideration of fortress combats received a decided change.

Heretofore the Siege Artillery had to combat the enemy in the first artillery position from three thousand to four thousand meters and from the second of twelve hundred to two thousand meters.

In the case of fortresses the first artillery position was in the forts and supporting batteries, to hinder the lodgement and advancement of the besiegers in the foreground, the artillery reserve was brought up and placed in the spaces in the line of the forts. The entire fortress artillery had been the task to annoy the development of the siege artillery or if possible to prevent the same.

About this time, on account of the construction of an effective mortar of medium caliber, the mortar fire had become of great importance. Trial shooting had shown that the mortar in a gun combat with powder shells had a better effect at long range than the cannon. Still better became the effect against well covered objectives through the introduction of the explosive shell and the high angle falling shrapnel. In 1889, with the introduction of the smokeless powder, which also took place by the foot artillery, the taking up of concealed positions by the artillery grew in importance, as it then became very hard to locate.

The tactical deductions of this epoch were that the siege artillery, in a positon three thousand to four thousand meters distant behind a special protected position of the infantry, undertook its advance. The advance of the siege artillery was made two echelons. In the first echelon were the guns with their first assignment of

ammunion, transportation railroad, gun platforms and building material; in the second echelon, the remainder of the ammunition. The plan for the development of the siege artillery, that 21-centimeter mortar batteries were to be used against the forts, came about on account of the increased radial connection of the cannon batteries of the fortresses with their long-range shrapnel fire, thereunder came also the mass of the high angle batteries.

Through the orders of the brigade commanders, the batteries were assembled in groups and these were assigned to single troops. Every artillery siege train established a park in the vicinity of the transportation railroad; building and entrenching material were sent forward; the remaining part of the park stayed behind, being assembled out of the range of the enemy. From the park a forwarding train connected with the battery positions, the running of the same was conducted by the park director under orders of the brigade commander. The entire march was directed by the brigade commander, who also cared for the forwarding of ammunition and material. The armament of the batteries invisible to the enemy was accomplished during the day, the ones that could be seen were supplied with ammunition during the night and before firing commenced, and during the last night were supplied with guns. The siege artillery were to open up from the beginning with a superiority of fire (if possible, frontal shell fire and oblique shrapnel fire) upon the various targets to silence them, and at last prepare the works for assault. The fire was directed by the commander of the siege artillery. After the fortress artillery had been silenced, it had been provided for that several batteries should move forward.

The fortress artillery was, on account of the artillery effectiveness, to have an extended building program and complete preparation for its placement was under consideration. In the terrain between the forts, permanent protecting ramparts or battery coverings were erected in order to hasten the march up of the artillery reserve. Places for the men of the battery and the ammunition, and in places the road-bed for the transportation train were constructed. At important places guns to repel assault were found, as well as several cannon and their armored observation stations. In order to transmit the orders for the artillery, a wide network of telephones was provided for, already partially constructed. As

a fundamental principle, the distant and the nearer systems were kept separate. The artillery positon is therefore about five hundred to seven hundred meters behind that of the infantry. For the artillery development is therefore depended, by quick measure to get ahead of the enemy and to remain there; this was to be accomplished by providing teams for the batteries of the artillery reserve. Where the terrain for the mass artillery which was to be developed was insufficient, a part of the high angle fire batteries opened up fire behind the others. The problem of the fortress artillery remained the same; namely, not to let the besieger bring up his artillery.

In course of the first ten years of the new century, new principles were again brought forward. The rôle that the advance positions of fortresses should play also produced an effect upon the tactics of a fortress combat. It had been considered to do away with advanced positions. This was to be done as originally planned, by means of the field army, assisted by heavy field howitzers. The incresing strength of the defending material and, above all, the greater effective domain of the fortress artillery, produced the conviction, that to solve this problem siege artillery must be put in, which must have draught animals. The strengthening of the artillery defensive material also required more siege artillery; the direct control of an enlarged artillery mass did not seem possible in the future. In course of a few years, the commanders of troops became acquainted with principles for the use of the heavy artillery. It was conceded that in a field campaign and a fortress combat, that general principles were the same, except that for a combat for fortresses thorough preparation and greater time is required. So the requirements were given out to place the siege artillery under the commanders of divisions for the combat, and not as before under one commander. In the section of the attacking field the foot artillery brigade commander with his troops is placed directly under the command of the commander of that section.

On account of the strength of the modern fortresses, it appears that a longer period of resistance is to be expected than formerly. For that reason every possible shortening of the preparation for the siege is necessary. In order to hasten the unloading of the siege organizations, the part which contains the horses and wagons is unloaded further back, so that by having a number of unload-

ing places, the railroad can be utilized to its full capacity. The sequence of transportation is so arranged that the battalions that are to be used for shooting at airships and the ones to assist the investment troops, come first, then the park companies, then the necessary transportation railroads and a few ammunition trains, and then the remaining battalions and transportation trains follow. The ammunition trains are the very last. The stowing and storing of the material follows separately from the troops; only the mass of ammunition remains in the brigade park. The development of a part of the siege artillery against advanced positons, against aerial targets, for harassing the enemy's search for information and observations, for the co-operation in the repelling of a sortie, as well as the necessity to oppose a strong fortress artillery at first at long range and even at the limits of the effective fire zone, prohibits the opening up of a general cannonade. The circumstances, however, force that the artillery be advanced during the course of the combat. All directions and use of the artillery are given by the commander of the section, who gives the orders, while the artillery commander designates objectives or combat areas. The principles for the use of siege artillery are therefore similar to those of a field campaign; the artillery troops have become more mobile and are capable to cope with the many more problems than was formerly the case.

In a similar manner within the last ten years a change in the use of foot artillery in the defense of fortresses has taken place. Of special importance in this respect was that in equipping erected batteries, the artillery can even under the protection of outpost or advanced position at first go beyond the main position. Of quite a considerable influence was further that the foot artillery reserve was kept well together formed into troops with teams which were capable to quickly assist various detachments, but could also be used beyond the fortress. The active defense profited thereby considerably.

The combat at Port Arthur, which taught the important lesson for the attack and defense of fortresses, showed that the principal problem of the artillery also during a fortress combat is to clear the way to victory for the infantry.

The use of foot artillery by the attack upon a line of forts has made the same progress as the use of the same during a combat against fortresses. Originally the attack was carried on more like

siege operations with special artillery siege trains; but this became faster as the foot artillery with teams developed. Today this attack is made with heavy artillery, being so mobile that it can be made part of the marching column, it can in shortest time take up position. Mortars without a gun platform are also used.

The use of foot artillery as coast artillery has made no change as far as the combat principles are concerned. Only improvements in the armament, gun emplacements, observation systems and messing facilities have given the coast artillery greater combat strength and greater effectiveness.

Besides the activity of the foot artillery within and against fortifications, a new usefulness for it has sprung up inside of the last twenty-five years—co-operation in a field battle.

At the beginning of the nineties, the foot artillery with teams was only designated for a combat against blockading forts and entrenched positions. The foot artillery companies with teams marched in rear of the other troops. Improvement was desired in its rapidity on the march. Heavy and unsuitably constructed material for field use was responsible for this condition. The going into the firing position took quite a long time, as the gun platform had to be placed first and the battery field work had to be constructed. During the middle of the nineties it was conceived that the foot artillery with teams, under circumstances, could take part in a combat before the field works were completed. Readiness to march and readiness to fire became better after the introduction of the easily driven howitzer and which since 1897 did not fire a gun platform. The doing away with gun platforms required new sighting devices and especially the correction for the unevenness of the axles, which influenced the hitting ability by making the gun shoot to one side, especially for high angle fire. Then the introduction of the sighting arc, later the telescopic sight and the Bussolen sighting arc, sighting devices were created which answered the requirements and a quick laying of the pieces in covered positions was possible. At the end of the nineties also a field-like aspect with respect to battery field works was required, in that for howitzer batteries in a field combat principally weaker protection similar to those of the field artillery was considered sufficient against exploded particles. So at the end of the old century the heavy field howitzer batteries could be used quickly and successfully in a field battle. A heavy howitzer battery in 1900 found an opportunity to take active part in the expedition against China.

In the following years the question opposing the shielded batteries of the enemy became an especially urgent one. The field artillery had only little effect against the cannoneers, who were protected behind the shields. Up to this time the use of heavy artillery, not considering the blockading fortifications, was only intended against the cover of entrenched field positions. In 1900 the thought became prevalent that at the beginning of a combat, the heavy artillery of the field army should begin firing first on account of its long range in cases where the field artillery found considerable trouble in taking up positions on account of the enemy's fire. The difficulty of combating the shielded batteries brought the idea that the field and heavy artillery should fight them together. Trial shooting with heavy field howitzers against shielded batteries gave good results. After the introduction of the 1904 shell, the result was still better, so that visible shielded batteries were quickly destroyed or completely put out of action; against concealed batteries, whose position has been established through reconnaissance, the same result can be obtained after some time and expenditure of ammunition by covering a certain area.

The introduction of the heavy artillery in the marching column has been variously ordered according to its mobility. At first placed after the fighting troops, now, as a rule, it is assigned to the foremost division and marches at the end of the infantry. It is, however, placed further forward when necessary. Its observation wagons march usually at the head of the battalions, the light ammunition column in rear of the field artillery. Together with the field artillery it is under the command of the artillery commander. The heavy artillery takes up a position in rear of that of the Field Artillery. After opening fire, the enemy's artillery is opposed jointly by the field and heavy artillery. On account of the effect of the heavy field artillery it is made possible for the mass of the field artillery to be free to be used against the enemy's infantry. So, in course of years, the heavy artillery has become indispensable to field troops during a battle.

Within the last twenty-five years the foot artillery, on account of having a clear conception, has succeeded to master the sought-for problems and by diligent work to progress. With certainty it can be said that the artillery will be in a position, in case of war, to meet all requirements of a field battle or of a fortress combat.

TABLE I.

DIVISION OF THE FOOT-ARTILLERY IN 1888.

General Inspection Department of the Foot-Artillery.

4th Foot-Artillery Inspection Department.	3rd Foot-Artillery Inspection Department.	2nd Foot-Artillery Inspection Department.	1st Foot-Artillery Inspection Department.
8th Foot-Artillery Regiment of the Rhine.	3rd Brandenburg Foot-Artillery Regiment (General Master of Ordnance).	1st East Prussian Foot-Artillery Regiment.	Garde Foot-Artillery Regiment.
10th Foot-Artillery Regiment with	4th Magdeburg Foot-Artillery Regiment.	2nd Pomeranian Foot-Artillery Regiment.	5th Lower Silesian Foot-Artillery Regiment.
14th Baden Foot-Artillery Battalion.	7th Westphalian Foot-Artillery Regiment.	11th Foot-Artillery Regiment.	6th Silesian Foot-Artillery Regiment.
12th Royal Saxon Foot-Artillery Regiment.	9th Schleswig Foot Artillery Battalion.	2nd Artillery Depot-Inspection Department.	1st Artillery Depot-Inspection Department.
4th Artillery Depot-Inspection Department.	3rd Artillery Depot-Inspection Department.		
Attached: Staff and 1st Battalion 2nd Royal Bavarian Foot Artillery Regiment.			

Examining-Commission for Captains and 1st Lieutenants of the Foot-Artillery.
Artillery-Shooting School. Fire Control School.
Royal Bavarian Inspection Department of the Foot Artillery.
2nd Royal Bavarian Foot-Artillery Regiment. 1st Royal Bavarian Foot-Artillery Regiment.

DIVISION OF THE FOOT-ARTILLERY IN 1913.

General Inspection Department of the Foot-Artillery.

Foot-Artillery Shooting School.

3RD FOOT ARTILLERY INSPECTION DEPARTMENT		2ND FOOT-ARTILLERY INSPECTION DEPARTMENT		1ST FOOT-ARTILLERY INSPECTION DEPARTMENT	
6th Foot-Artillery Brigade.	5th Foot Artillery Brigade.	4th Foot-Artillery Brigade.	3rd Foot-Artillery Brigade.	2nd Foot-Artillery Brigade.	1st Foot-Artillery Brigade.
4th Encke Foot-Artillery Regiment (Magdeburg).	3rd Foot-Artillery Regiment (Brandenburg)	10th Lower Saxon Foot-Artillery Regiment.	8th Rhine Foot-Artillery Regiment.	1st Foot-Artillery Regiment of Linger (East Prussian).	2nd Garde Foot-Artillery Regiment of Hindersin (1st Pomeranian).
18th Thuringian Foot-Artillery Regiment.	General Master of Ordnance: 7th Westphalian Foot-Artillery Regiment.	13th Hohenzollern Foot-Artillery Regiment.	16th Loraine Foot-Artillery Regiment.	1st West Prussian Foot-Artillery Regiment, No. 11.	5th Lower Silesian Foot-Artillery Regiment.
20th Foot-Artillery 19th Regiment (Lauenburg).	Schleswig Holstein Foot-Artillery Regiment.	14th Baden Foot-Artillery Regiment.	12th Saxon Foot-Artillery Artillery Regiment.	2nd Pomeranian Foot-Artillery Regiment No. 15.	6th Foot-Artillery Regiment of Dieskau (Silesia).
19th Saxon Foot-Artillery Battalion.			2nd Bavarian Foot Artillery Regiment (attached).	2nd West Prussian Foot-Artillery Regiment, No. 17.	
3rd Artillery Depot Direction Department.		4th Artillery Depot Direction Department.		1st Artillery Depot Direction Department.	
Foot-Artillery Shooting Range Wahn.				2nd Artillery Depot Direction Department Higher Fire Control School.	
				Foot-Artillery Shooting Range.—Thorn.	
rd Bavarian Foot-Artillery Regiment.		Bavarian Foot Artillery Brigade. 2nd Bavarian Foot-Artillery Regiment.		1st Bavarian Foot-Artillery Regiment.	

TABLE II.

TABLE II.

REVIEW OF THE GUNS OF 1888.

Kind	Gun	Use	Material	Breech mechanism	Sighting device	Gun carriage	Ammunition Kind	Ammunition Weight, kg.	Maximum Range, M.
Medium direct fire gun	Heavy 12 c/m C.	Spec. Art. Siege-troops Siege and fortress	Hard bronze	Round wedge	Brass	High wheeled Gun-carriage	Powder Shell Shrapnel Bag-charge	16.2 19.8	 7200
Heavy direct fire gun	15 c/m C.	Siege and fortress	Steel with steel hoops	Round wedge	Gunner's quadrant	Same	Powder shell Shrapnel Bag-charge	27.75 39.58	7500 4700
Medium high angle fire gun	15 c/m short C.	Spec. art. Siege troops	Bronze, hard bronze lining	Flat wedge	Wooden gunner's quadrant	Same	.....	.....	.....
	15 c/m mortar	Siege and fortress same	Hard bronze	Screw	Gunner's quadrant	Block carriage with transport and firing wheels	15 c/m M. also gun-cotton shell	39.6	3250
Heavy high angle fire gun	21 c/m Mortar	Same	Bronze	Wedge	Same as short 15 c/m C.	Sledge carriage with transport and firing wheels	Powder shell Gun-cotton shell Bag-charge	79.0 144 0	3900

TABLE II.

REVIEW OF THE GUNS OF 1913.

Kind	Gun	Use	Material	Breech mechanism	Sighting device	Gun carriage	Ammunition Kind	Ammunition Weight, kg.	Maximum range
Medium direct fire gun	10 c/m Cannon 04	Siege and fortress	Steel, steel jacketed and hoops	Rapid fire breech mechanism	Telescopic sight	Gun-recoil carriage	Explosive shell cartridge Shrapnel cartridge	Projectile 18	Over 10 Km.
Heavy direct fire gun	13 c/m C	The same			Panoramic telescopic sight	Gun-recoil carriage with wheel belts	Explosive shell Shrapnel separate Encased charge	?	Over 12 Km.
Medium high angle fire gun	Heavy field Howitzer 1902	Heavy artillery Siege and fortress			Telescopic sight	Gun-recoil carriage	Explosive shell Separate encased charge	40	7400 M.
Heavy high angle fire gun	Mortar	Same			Panoramic telescopic sight	Gun-recoil carriage with wheel belts	Explosive shell Separate encased charge	119	About 8000 M.

THE NEW FIELD ARTILLERY ARM.

By Captain John Lund, Ordnance Department.

Before discussing the various features found in the latest field gun of the United States it may be of interest to give a sketch of the development of Field Artillery. The object of Field Artillery has always been to enable an army to throw destructive agents at long distance targets, and the developments have been carried on with a view of increasing the power so that large masses could be thrown with great accuracy.

There are many people who are under the impression that Field Artillery is of a comparatively recent origin. This, however, is far from the truth. We find reference to it in the Bible, as, for instance, in the Chronicles, where it is stated that the walls of Jerusalem were armed with machines for throwing arrows and large stones (about 800 B. C.). These machines were also used extensively by the Greeks, Romans and Macedonians, and later by the Gauls. They were called by various names, the most common being the catapult and ballista, the latter consisting of an arm, actuated by a spring, and to the end of which was suspended the shot or burning liquid (see Plate 1).

Although these machines were probably considered as the wonders of the age, it was not until after the invention of gunpowder that the importance and possibilities of the Field Artillery weapon began to be realized. It was from the first crude mortar, shaped probably to resemble the apothecary's mortar in which Berthold Schwartz was mixing saltpeter, charcoal and sulphur, and from which, by accidentally dropping a spark in this mixture, the covering stone was thrown with great violence, that by scientific progress was developed the machine of today.

That the field artillery weapon using gun powder was soon recognized as a powerful asset for an army, and that at the same time it was not considered as a very sportsmanlike weapon is evidenced by the following extract from Miguel Cervantes' "Don Quixote," written about the year 1600: "Happy those days which knew not the dreadful fury of Artillery! Those instruments of hell—by means of which the cowardly and the base can deprive the bravest soldiers of life." (See Plates 2 and 3.)

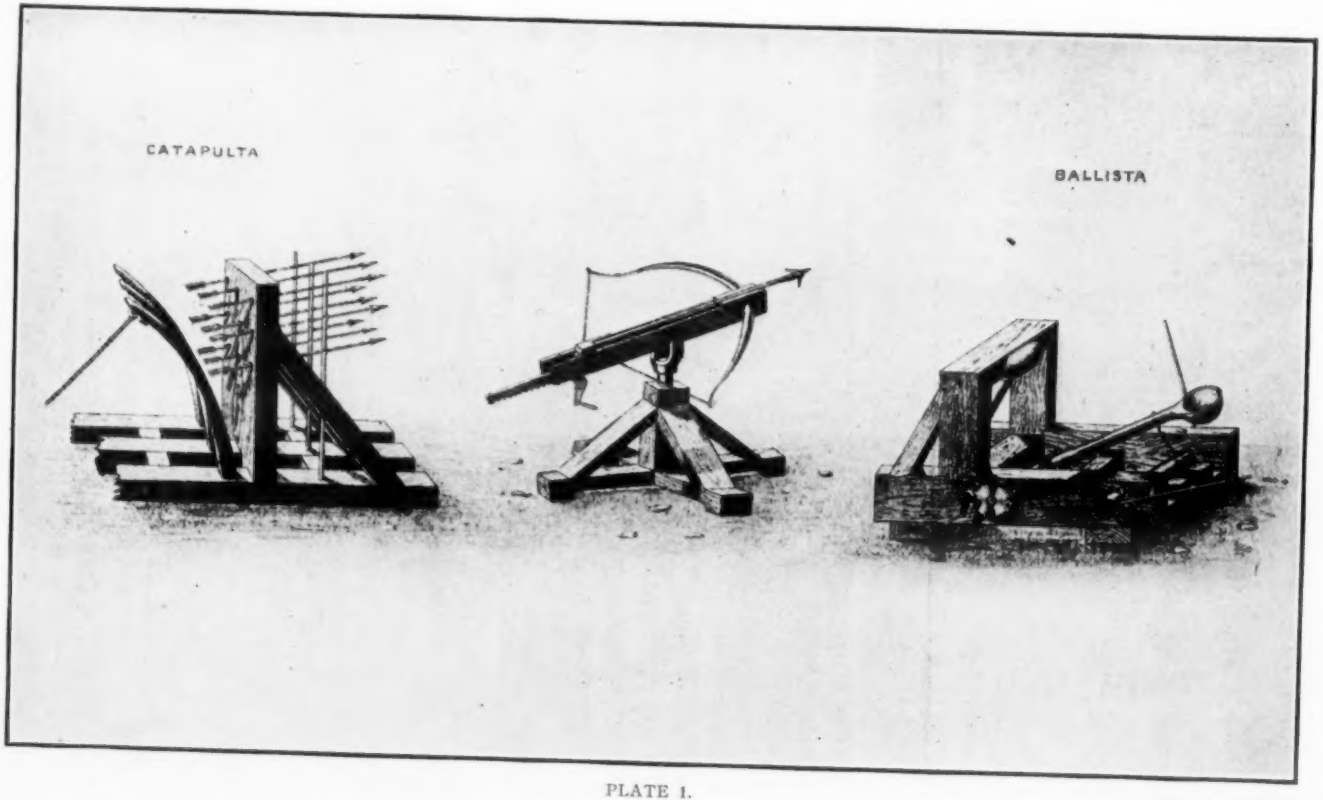

PLATE 1.

It would be tedious here to follow the developments and improvements in Field Artillery from the time of the invention of gun powder until the time of our Revolution, nor would such a study show wonderful improvement as viewed from today.

At the time of the Revolutionary War we find the smooth bore, muzzle loading guns, provided with trunnions resting on trunnion beds of a two-wheeled carriage. The carriage was provided with two flasks, tied together, to form a trail. The carriage recoiled on the ground during firing and the aiming was done by coarse sights. (See Plate 4.)

This gun and carriage remained in use with few improvements until after the Civil War. At that time we find the double flasks forming the trail replaced by a single trail called the stock. To increase the accuracy of fire, a rotational velocity was imparted to the projectile in about one-third of the guns used during the war. The guns were still loaded from the muzzle and rotation was imparted to the projectile by adding a soft substance at its rear end which by the pressure due to the powder was forced out into the spiral grooves of the bore. The guns were loaded from the muzzle while the carriage still recoiled on the ground, making aiming and firing slow and laborious. (See Plate 5.)

From this time on, improvements in field cannon, as well as other firearms became more and more frequent Probably the great advancements in the manufacture of steel had as much to do with this as any other one factor, since stronger guns and carriages could be made for the same weight.

The first modern all-steel gun and carriage made its appearance in our service about 1890. This gun fired a 3.2-inch projectile, weighing 13.5 pounds. This gun for the first successful time was loaded from the breech, the breech end of the gun being closed after loading, by a breech block held in place by an interrupted screw. (See Plate 6.)

The next epochal step with the 3-inch gun and carriage, model of 1902, in which the gun is permitted to recoil on its carriage, thereby reducing the shock of discharge and making it practicable to fire without seriously disarranging the aim. (See Plate 7.)

Every one is familiar with this gun; and the service it has rendered probably cannot be surpassed by any similar gun in the world. At the same time, it possesses certain limitations which with the

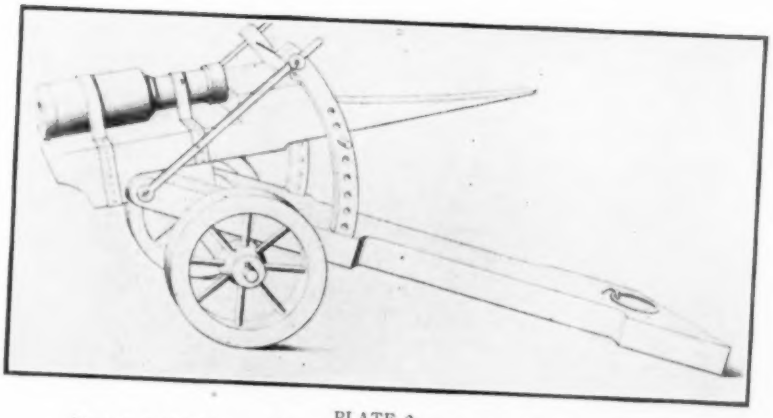

PLATE 2.

First form of field gun. Used during the latter part of the 15th Century.

PLATE 3.

Another form of 15th Century Field Gun. With the horse behind the gun it was possible to run the gun into the firing position under cover of the shield. This gun was fired without unhitching the horse.

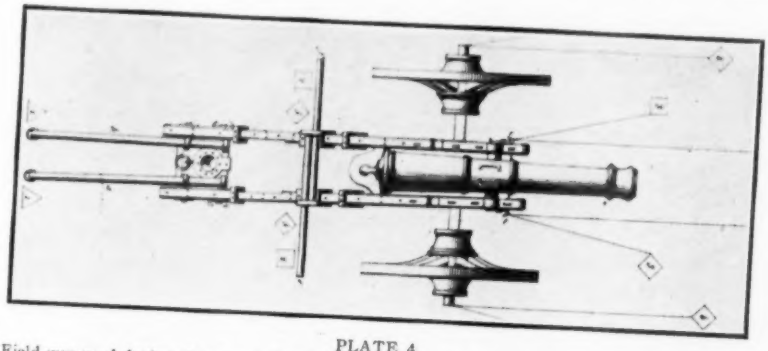

PLATE 4.

Field gun used during the French Revolution. Also used during the American Revolutionary War.

present method of warfare are sufficient to demand that its scope and sphere of action be enlarged.

To be successful in a field artillery engagement under modern conditions, it is probable that aside from the power and accuracy of the gun, the most important characteristics that a gun for light Field Artillery must possess are mobility and rapidity of fire.

Of the two it is unquestionably true that the latter is the more important and that if necessary to add additional parts to increase the rapidity of fire, a slight increase in weight with corresponding loss of mobility is necessary and justifiable.

In the new 3-inch gun and carriage the power and accuracy of the gun proper have not been changed from those of the 1902 model. A discussion of how the rapidity of fire has been increased, follows:

The limitations of the 3-inch, 1902 model, may be summarized as follows:

1. The carriage is not anchored until after the spade is seated in the ground, requiring the first shots to be fired with the lanyard, resulting in seriously dislocating the aim.

2. The traverse is limited to 6 degrees, necessitating moving the trail if the target has a wide front, or if the target is moving across the field of fire.

3. The elevation is limited to 15 degrees limiting the extreme range and incidentally preventing its use against aeroplanes.

4. The sighting system is arranged so as to make it impracticable to separate the laying of the gun in direction from that of elevation.

5. The breech block must be opened and closed by hand.

It is to overcome these limitations, and at the same time retain the required rugged strength and mobility required for our service, that the 1913 model 3-inch gun carriage was constructed. (See Plates 8 and Frontispiece.)

Credit of the main ideas must be given to Colonel A. Deport who undoubtedly was the first to suggest a practicable split trail construction. The details of the construction have been materially changed to suit our service.

A description of the improvements as incorporated in this new design is given below. As stated above, the ballistics of the gun are the same as in the old model. The principle of the recoil mechanism is the same as is used on our howitzer carriages. The arrangements of the parts, however, are changed in that the recoil cylinder is on top of the gun, and the springs below.

PLATE 5. FIELD GUN OF THE CIVIL WAR.

From an actual photograph of a Confederate emplacement before Atlanta.

The advantage of this arrangement is that it permits the center of gravity of the recoiling parts to be located exactly on the axis of the bore. With this arrangement the tendency of the powder gases to revolve the recoiling parts around its center of gravity is removed with the result that the stresses are reduced which again permits lighter parts be used. This arrangement also does away with the "jump" of the projectile. It will be noted from the range tables of the 1902 field gun that the angle of departure is different from the angle of elevation. This is due to the fact that the center of gravity of the recoiling parts in that carriage is below the axis of the bore. The powder pressure acting on a lever arm equal to the distance between the axis of the bore and the center of gravity, creates a moment which rotates the gun during the time of the action of the powder. This rotation causes the angle of departure of the projectile to be different from the original angle of elevation of the gun by an amount called the "jump." This moment, together with the piston rod pull, will also under certain conditions, cause the wheels of the carriage to be lifted off the ground. This is very often referred to as the jump of the carriage. This latter jump, however, does not affect the trajectory since the movement does not occur until after the projectile has left the bore. In the 1913 model the angle of departure should be the same as the angle elevation.

The methods used in overcoming the limitations of the 3-inch 1902 model as enumerated above are as follows:

1. To anchor the carriage for the first round, driven spades are used, and the first operation of the cannoneers when going into action is separating the trails and driving these spades, by means of mallets carried on the outside of each trail flask.

In case the soil is of such a nature that spades cannot be driven, ratchet teeth are provided so that the spades may be held a short distance below the bottom of the float and the carriage may then be fired the same as the 1902 model.

2. The traverse of the gun on its carriage has been increased to 45 degrees. To accomplish this, the trail is made in two parts hooked together for traveling but separated for the firing position. A top carriage supporting the recoil parts, traverses in a pintle which again is part of the axle.

To insure stability of the carriage, and also in order to permit the carriage to be placed on uneven ground in which case one spade

PLATE 6. 3.2-INCH GUN AND CARRIAGE.

might be higher or lower than the other spade and the two wheels, the flasks are connected to the axle and pintle by means of a universal joint permitting one flask to be raised 18 degrees above the other.

3. The elevation has been increased so as to obtain the longest range possible with the projectile and charge used. This is obtained at about 40 degrees elevation. In addition, however, the gun can be elevated further and a special sight will probably be issued by means of which this gun can be used for firing at aeroplanes.

The system of sighting used on this new carriage is called the independent line of sight. The object of this system is to increase the speed of sighting. It would perhaps be difficult to define in a few words the meaning of an independent line of sight. It may broadly be defined, however, as being a construction in which the duties and operations necessary for laying in direction may be performed entirely independent of the duties to be performed for giving the gun the necessary elevation for any range. It is accomplished by placing between the gun and the top carriage proper an intermediate carriage called the rocker.

This rocker carries on its left side the panoramic sight while to its right side is attached an arm carrying a movable index pointer which may be set at any given figure, depending on the angle of site of the target. The gun and cradle proper rest on this rocker and to the cradle is permanently attached a range scale so arranged that it moves with reference to this movable pointer.

The traversing hand wheel is located on the left side as is also the rocker elevating hand wheel. Both of these act in bearings connected to the top carriage proper. On the right side is located another rocker elevating handwheel and also an elevating hand wheel for the gun cradle. The gun cradle elevating hand wheel is fixed in bearings in the rocker. The firing handle for the gun is located on the left side while a fixed level is attached to the rocker on the right side. With this arrangement it is possible to elevate or depress the rocker both from the left and the right side. This elevation or depression is so that the rocker may be inclined an amount equal to the angle of site of the target in direct laying. For indirect laying the rocker is left level and the movable index pointer moved up or down instead.

With this arrangement it will be noted that to move the gun does

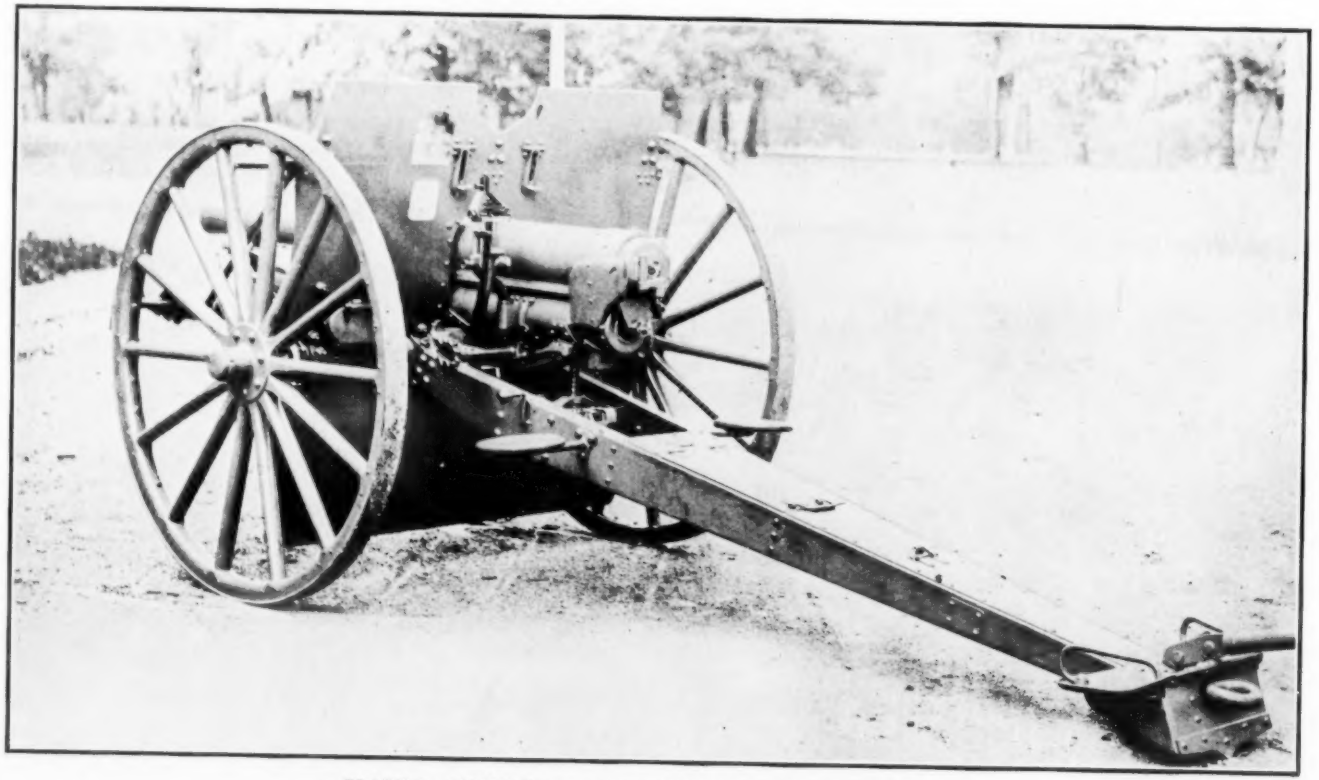

PLATE 7. 3-INCH FIELD GUN CARRIAGE. MODEL OF 1902.

not disturb the rocker with the panoramic sight attached to it and the panoramic sight, therefore, remains sighted on the target. Similarly once the sight is aimed on the target the elevation may be changed in a moment by a turn of the elevating hand wheel without disturbing the laying. The gunner does not have to concern himself about the elevation, his only duty being to aim the sight and fire the piece.

The duties to be performed are as follows:

For Direct Laying.—The gunner on the left side elevates the rocker and traverses the top carriage until the cross hairs are on the target. This being accomplished, the rocker will be inclined equal to the angle of site of the target while the direction in azimuth of the gun is toward the target. As soon as No. 1 reports ready the gunner fires the piece.

While the gunner performs his duties No. 1 on the right side elevates the gun which changes the relation between the gun and the rocker. The movable index pointer is placed at 300 and a correct elevation of the gun is obtained when the proper range reads opposite this pointer.

It will be noted now that the elevation of the gun is the angular elevation given on the right side, plus the elevation due to the inclination of the rocker given by the gunner on the left side. It will also be noted that by elevating the gun on the right side the position of the rocker, and therefore, the position of the panoramic sight, is not affected.

For Indirect Laying.—If indirect laying is to be used the first duty to be performed on placing the gun on the firing line is for No. 1 to level the rocker by means of the level attached on the right side and by using the rocker elevating hand wheel on the right side. As soon as the proper commands are received, the duties to be performed are then as follows:

The gunner sets the deflection as ordered on the panoramic sight and traverses until the vertical hair is on the aiming point. As soon as No. 1 reports ready, the gunner fires the piece. At the same time the gunner performs his duties, and independently of him No. 1 moves the index pointer until the correct angle of site setting is obtained. He then elevates the gun until the proper range is read off on the range scale opposite the pointer.

It will be noted that the gun has now the proper direction, given

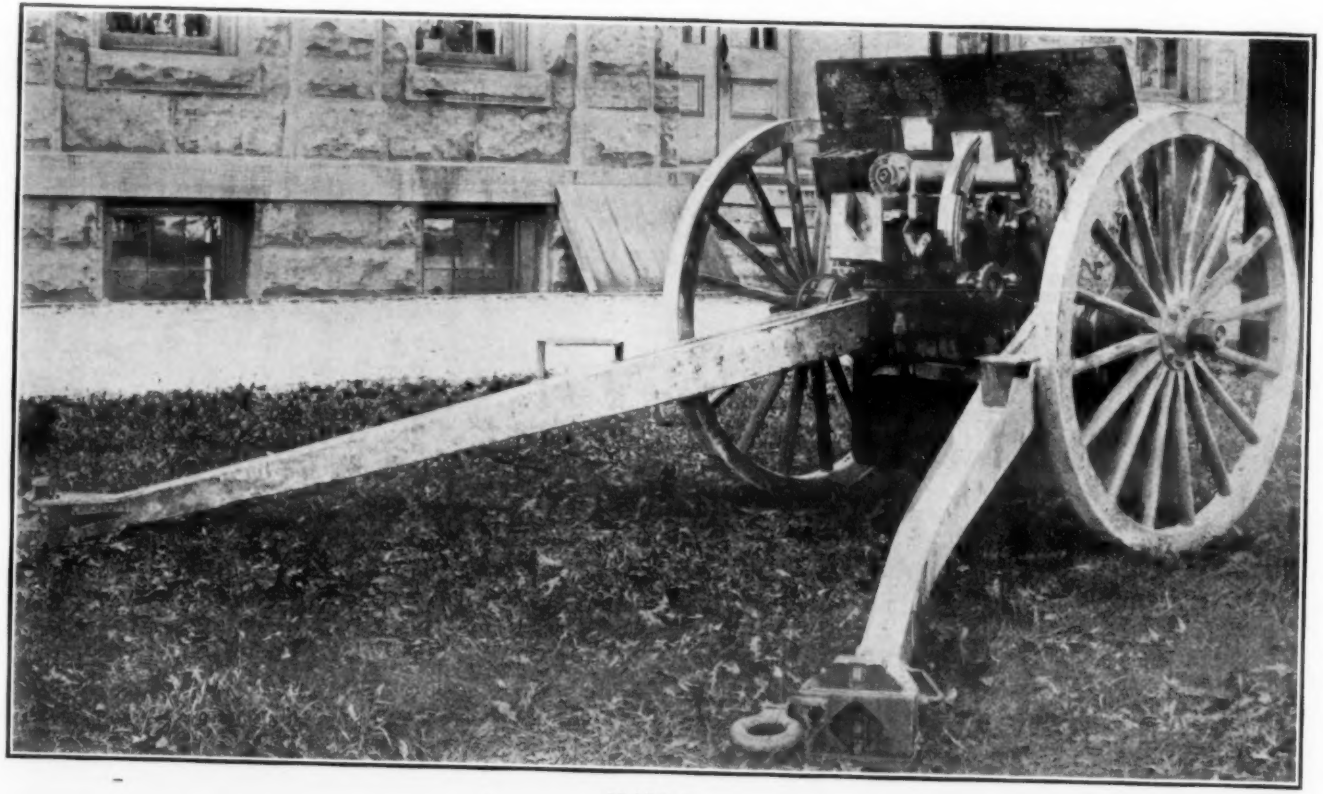

PLATE 8.

Right rear view of the 3.8-inch Howitzer carriage, Model of 1913. This carriage has the same construction as the 3-inch gun carriage. This view shows the rocker elevating hand-wheel below and the gun and cradle elevating hand-wheel above. The range scale is shown in place; but the index pointer has been removed. The arc on which it slides is shown directly in rear of the cradle elevating hand-wheel. The rocker level is shown on the rocker immediately above the rocker elevating hand-wheel.

by the gunner, while the angular difference between the gun and the rocker is the range table elevation plus the angle of site of the target. In this respect it is different from that had in direct laying, in which case the angular difference was the range table angle while the rocker was inclined equal to the angle of site of the target.

The panoramic sight must be corrected for difference of level of wheels the same as in the 1902 model but in this new model after it is once levelled it automatically corrects itself for any other elevation of the gun. This is accomplished by mounting the panoramic sight on an axis which is rotated by a link motion in such a way that it is always parallel to the axis of the bore. It will be noted that the panoramic sight is not moved up or down as is the case in a 1902 model, but remains always in the same position no matter what the elevation of the gun may be. Similarly on the right side it is not necessary to move a sight shank and then elevate, but instead the gun is elevated until the proper range on the range strip is opposite the index pointer.

A semi-automatic breech mechanism is used so that the block is automatically opened on counter recoil and the empty case ejected. A spring is used so that the block is automatically tripped and closed by a spring action as soon as the projectile is inserted.

THE SUBSTITUTION OF THE BREAST COLLAR FOR THE PRESENT STEEL ARTILLERY COLLAR.

By 1st Lieutenant Francis W. Honeycutt, 3rd Field Artillery.

As a matter of historical interest, the present artillery collar was introduced in the year 1892 or 1893. The report of the Chief of Ordnance for the latter year contains the following remark on page 49:

> Steel collars have been issued to each battery of light artillery, and reports generally indicate that they are very suitable for the military service.

I am informed that these collars were first noticed in use by fire-engine horses in Kansas City by an able field artillery officer stationed at Fort Riley. This officer had seen service throughout practically all of the Civil War, and had a particularly fine record in every way. He succeeded in having the collars tried out, and, favorable reports being received, the Ordnance Department issued them to all of the batteries.

Taking into consideration the excellent results obtained by regular organizations, or rather some regular organizations, under experienced officers who are experts on subjects connected with animals, it is easy to see that this action was entirely logical and natural. With a few exceptions, however, all favorable ideas we have about the collar are based upon marches in time of peace by regular troops. The mechanical advantages of the steel collar over the breast collar are too evident to dwell upon.

A general officer of much field artillery experience says that he thinks the steel collar is undoubtedly the best form of traction for fire engines; they do their training under the same conditions that they meet in their work. The general is one of the officers who would prefer to take the field with breast collars rather than steel collars were he in command of an organization; this is due to the almost unsurmountable difficulties which are liable to arise with the steel collar in a hard and protracted campaign. Among our senior experienced officers and other younger officers whom I have had the privilege of hearing express their views on the subject, the following opinion seems to be quite general: that due to conditions in the militia batteries, and due to the fact that there must be many hastily formed volunteer batteries in time of war, we

should find a substitute for our steel collar. There are even some who believe that we should do this not only due to the above conditions but also on account of conditions which are ever present in time of peace, and which will exist to a much more decided degree in time of war: namely, lack of skill in some regular organizations in fitting the present collar, and the comparatively large amount of time and energy which must be expended on a hard march in the task of endeavoring to keep the collars fitted as the horses fall off in flesh.

One of our colonels states that he is convinced that less harm will be done to our horses with the breast collar than with the steel collar. This is an officer who says that he would prefer the steel collar for marching in his own organization were he in command of one in the field; but he is very decided about the advantages of the breast collar for our purposes, and thinks that it should be adopted.

On taking the field we should probably obtain the maximum efficiency if the following recommendation by one of our senior officers were carried out, that the militia be equipped with the breast collar, that those regular officers who so desire retain the steel collar, that the remainder of the regular batteries be equipped with the breast collar. The question here arises as to whether the same officers will remain in command of their organizations throughout a campaign. Another thought is suggested: will there not be those lacking in experience who would choose the steel collar, not realizing that they might be incompetent to fit it?

There is another fact which should be borne in mind. Many officers have a natural ability along these lines. When such an officer is lucky enough to join a command where the collars are fitted well, he will see all of the advantages, none of the disadvantages, of the present system. As he goes along he will see that the collars under his immediate supervision are properly fitted. It seems quite possible that an officer might serve for several years before seeing any of the very serious results due to badly fitting collars.

Badly fitting collars and lack of experience with horses will result on ordinary marches in some sore shoulders and the substitution of a few dutch collars, or the replacing of a few horses in the teams. On severe marches the same conditions may result in the immobilization of a unit. This is one of the very few things

that I have learned from personal observation during my short service; and an experience of this kind leaves a rather decided impression.

The following are of interest:

1. From the commanding officer of a regiment, personal letter to an officer of the General Staff: The breast collar seems to be steadily gaining in favor. I think all my officers who are using it—at least those in whose judgment I have the most confidence—are in favor of it. I used not to be. Here follow reasons which caused this opinion, but which no longer exist.

2. Battalion commander, 1st Battalion, 3rd Field Artillery: It is my opinion that a modification of this harness will be necessary for issue to hastily mobilized batteries in time of war. Of the memorandums of four lieutenants in this battalion two were favorable and two were unfavorable for the breast collar.

3. Commanding officer, Battery E, 6th Field Artillery: Report very favorably for breast collar.

Commanding officer, 6th Field Artillery: Recommendations: . . . That an entire battery be equipped with the breast collar and that it be given a year's trial. . . .

One battery of the 6th Field Artillery is now equipped with the experimental harness. This harness has the following modifications of the harness as first issued: breast strap of three folds, zinc pad for neck strap, metal form plates for ends of breast strap.

An officer of field artillery had occasion to look over the horses of a French battery in position near Compiegne on October 4. The horses were standing in harness and had been so for four days. The battery had been in all of the fighting since the opening of the campaign, and more important for the illustration, in all of the terrific marching. They looked like skeletons with hide hung over them, their necks withered away to almost nothing. The breasts were examined as far as possible in the time available, and no sore breasts were found. The skin was not smooth, but was like the palm of a man who has been rowing all summer.

In strategy, tactics, style of writing, speaking in public; in fact, in all lines of work, simplicity is to be sought. I ask those who have seen harness fitting properly conducted and have gone through a march where the horses have fallen off greatly, which would be the simpler—the steel collar or the breast collar? Harness and its fitting takes up a great part of one of the two big divisions of our work in service, the problem of "getting there." To those who

have fought an unsuccessful fight in trying to keep horses fitted on a severe march, I believe the feeling of relief would be great in knowing that the breast collar would at least always fit, and that the problem would be resolved into keeping the collar at the proper place and keeping it clean. The breast collar would be of the greatest help to an officer organizing a new unit and hoping to get it ready for the field as quickly as possible. The care and worry taken from a man's mind would be no small item at such a time. Assuming that all of the new units could be fitted with the steel collar, and kept perfectly fitted, under these conditions, we know that the moments would be precious, and let us consider carefully how much time we would gain by the use of the other system.

The following list of warnings in regard to the common errors and abuses which too often are allowed to exist in the management of artillery teams in draft have been prepared by the author of the foregoing article and are worthy of the most careful consideration by every officer, every noncommissioned officer and every driver of the Field Artillery, both in the Regular Army and the Organized Militia.

1. DON'T whip your horse when he is pulling his heart out.

2. DON'T try to make a team pull out of a place when there is a question as to whether they can do it or not. In other words, don't teach them to fail.

3. DON'T think it is a disgrace for the cannoneers to help a team. For a short distance, five men can pull as much as one average horse on level ground, and more than one horse on an up-grade. The artilleryman of the great master of artillery dragged their guns all over the battle fields.

4. DON'T fail to give the horses a breathing spell and to chock the wheels as often as possible on a hard pull.

5. DON'T think that the reputation of a battery is blasted if a good team stops to ask for a chance to blow or to beg for help.

6. DON'T try to whoop, whip or curse them through a hard place. The measure of excellence in driving is the quiet on a hard pull, possibly broken only by a few low encouragements. "Take it with a rush" indicates ignorance and inefficiency.

7. DON'T think a horse is a machine.

8. DON'T hit your horse in the face because he is thirsty and wants to drink out of a bucket at the same time as his teammate.

9. DON'T fail to dismount your drivers at every opportunity.

10. DON'T try to regulate the gait of teams in heavy draft by the gait of a single nervous horse.

OBSERVATION MASTS AND LADDERS.

AS USED IN THE SECOND BATTALION, THIRD FIELD ARTILLERY.

By 1st Lieutenant Dawson Olmstead, 3d Field Artillery.

The necessity for some form of observation mast or ladder has made itself felt to such an extent that almost every battery of our Light Artillery has provided itself with some type of improvised equipment of this character. It is believed that this need is now generally recognized and that the Ordnance Department has only delayed the issue of some such equipment pending adoption of the most suitable design.

It is not therefore the object of this paper to dwell upon the many advantages incident to having a good mast or ladder included in the equipment of a battery nor to point out the material assistance to be derived from its use but to describe briefly the equipment of this character employed by the 2d Battalion, 3d Field Artillery.

Each of the three batteries has a mast or ladder designed in the respective batteries and made up by the battery mechanics. This equipment was, in every instance, carried on one of the fifth section caissons and was set up each day the batteries fired during the entire season's firing at the Camp of Instruction for Field Artillery held

FIGURE 1—BATTERY D.

FIGURE 2—BATTERY E.

FIGURE 3—BATTERY E.

FIGURE 4—BATTERY E.

FIGURE 5—BATTERY F.

FIGURE 6—BATTERY F.

at Tobyhanna, Pennsylvania, during the months of June, July and August, 1914.

Battery D has an iron mast which weighs 120 pounds, stands 25 feet, 8¾ inches above the ground and has rope guys. The mast itself consists of two sections with projecting rods for steps. The upper section which has a detachable seat may be used alone when it will afford sufficient elevation. The mast may be erected from the trail of the caisson or from the ground and can be erected by four men in one minute and fifteen seconds. The advantage of this type is that it may be carried to a distance from the caisson and be erected wherever the battery commander may locate it without respect to practicability of moving the caisson to the spot selected. This mast is shown in Figure 1.

Battery E has a sliding extension wood ladder of three sections with detachable seat weighing entire 124½ pounds. It stands 36 feet above ground when fully extended although one, two or three sections may be employed depending upon elevation desired. Two sections afford a height above ground of 24 feet or two sections may be formed into a step ladder 12 feet high as shown in Figure 2. The sections may also be employed as stretchers as shown in Figure 3. The ladder rests on the ground when erected and a noncommissioned officer and four men set it up in 2½ minutes. When fully extended two sets of guys are used. This ladder is shown in Figure 4.

Battery F has an iron mast made in two sections very similar to that of Battery D. The upper section is provided with a cross tree, to which a battery commander's telescope may be attached. This section is also provided with a seat. Rope guys are used. This mast is erected from the trail of the caisson, stands 20 feet and 5 inches above the ground, and is erected by three men in 1½ minutes. The two sections of this mast are set in metal collars which are in turn held between the cross rails of the caisson by a cross-piece. For the traveling position the collars rotate in a vertical plane to a position very near the horizontal so that the upper ends of the sections rest upon the caisson body. When the mast is to be erected the smaller section is taken out of its collar and jointed to the upper section, and the jointed mast is then rotated in the collar of the larger section to the vertical and guyed. The smaller section alone may be rotated to the vertical in its collar when an elevation of but 10 feet or less is desired. This type is perhaps the easiest to erect

but has the disadvantage of depending upon the caisson for erection. This mast is shown in Figures 5 and 6.

Battalion Headquarters also has a mast similar to those of D and F Batteries which is carried upon the reel cart.

As was stated above, this equipment was in almost daily use for a protracted period. No accidents occured and the equipment was at times indispensable due to thick undergrowth that covered the terrain.

"GOERZ" ARTILLERY RANGE FINDER, E 115—ONE METER BASE.

The requirements which must be filled by a range finder to be of any use in war, are chiefly

1. Easy manipulation.
2. Rapid location of target.
3. Rapid measuring.
4. Possibility of measuring also distances of moving targets.
5. Insensibility to mechanical and thermal influences.
6. Sufficient exactness in measuring.
7. Possibility of rapid and easy correction of errors.

DESCRIPTION.

The Goerz range finder for field artillery, one meter base (Figs. 1 and 2) consists of

1. The range finder proper.
2. The tripod.
3. The adjusting bar.
4. The accessories.
5. The storage box.

1. The Range Finder.

a Eye-piece.
a′ Finder.
b Measuring screw.
c Distance scale.
d Protection for height adjustment screw.
e Protection for distance correction screw.
f Scale for distance correction screw.
g and g′ Entrance apertures.

2. The Tripod.

h Legs.
i Metal tubing extensions.
k Locking screws for "i."
l Locking lever for "h."
m Locking lever for pivot.
n Circular scale.
o Scale ring.
p Lateral adjustment screw with scale drum.
q Disconnecting lever for "p."
r Locking lever for tilting joint.
s Height adjustment screw.
t Spirit level.
u Level screw.
v Lever for locking range finder in vertical position.
w Hook for fastening range finder.
x Tripod locking bolt.
y Hook-bolt for range finder.
z Locking head for tripod.

3. The Adjusting Bar.

The adjusting bar is for the purpose of examining range finders as to their exactness in measuring and their adjustment, if required. The bar is set up at least 100 meters distant from and parallel with the range finder. For this purpose the bar is provided with short, hinged, movable legs, so that they can be placed various distances apart and folded up. At both ends the bar is marked with a line: the distance between the lines is equal to that between centers of the entrance apertures of the range finder (base). A finder is provided in the center of the bar, which is turned up while in use, to adjust to the range finder. When the sighting line of the finder cuts the center of the range finder—the directions of both, in horizontal position of bar and range finder—and, consequently also, the rays of the line marks to the opposite entrance apertures of the range finder run parallel.

4. Accessories.

2 Color screens.	1 Piece chamois skin.
2 Sun screens.	1 Brush.

5. The Storage Box.

A wooden box is furnished for storage and transportation of all range finder parts.

6. Remarks.

The eye-piece is adjustable to the eyes of the observer and is equipped with diopter arrangement.

The spirit level "t" serves for measuring angles of site, which are read from scale drum on the level screw "u" and the coarse scale on the level carrier.

Optical Data.

Invert system	
Magnifying power	15x
Actual field of view in degrees	2° 40′
Actual field of view at 100 meters in meters	46 meters
Entrance pupil	37.0 millimeters
Exit pupil	2.5 millimeters
Illumination	6.25 millimeters
Shortest distance measurable	600 meters

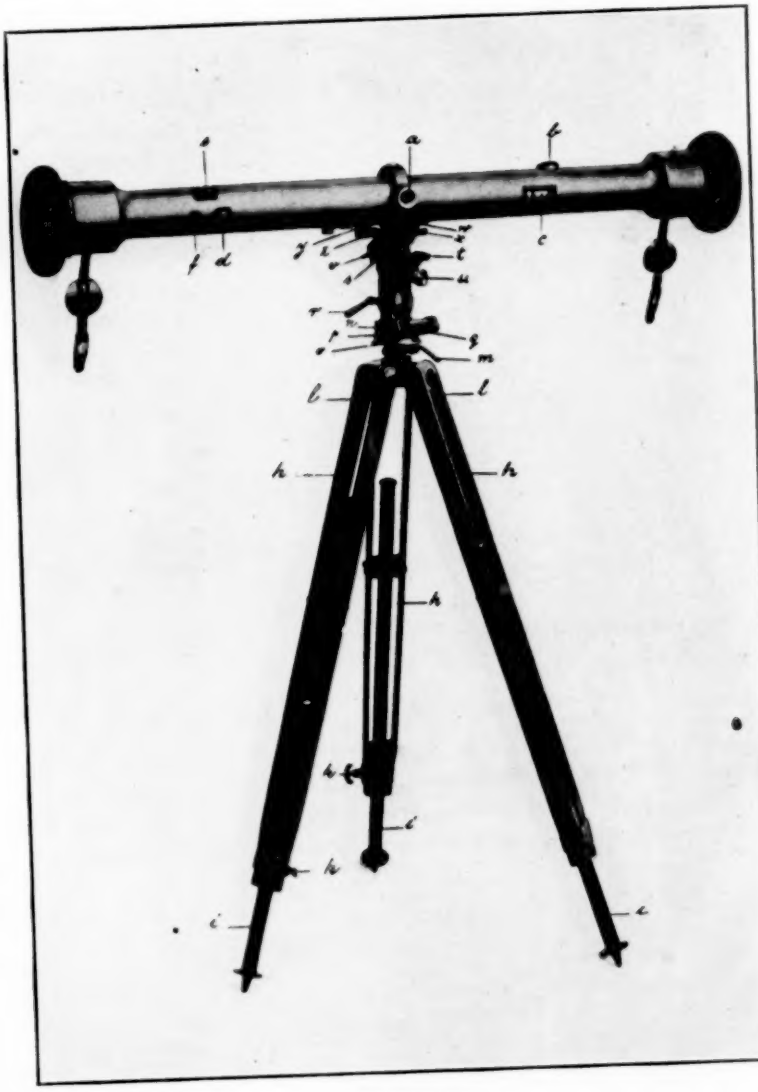

FIGURE 1.

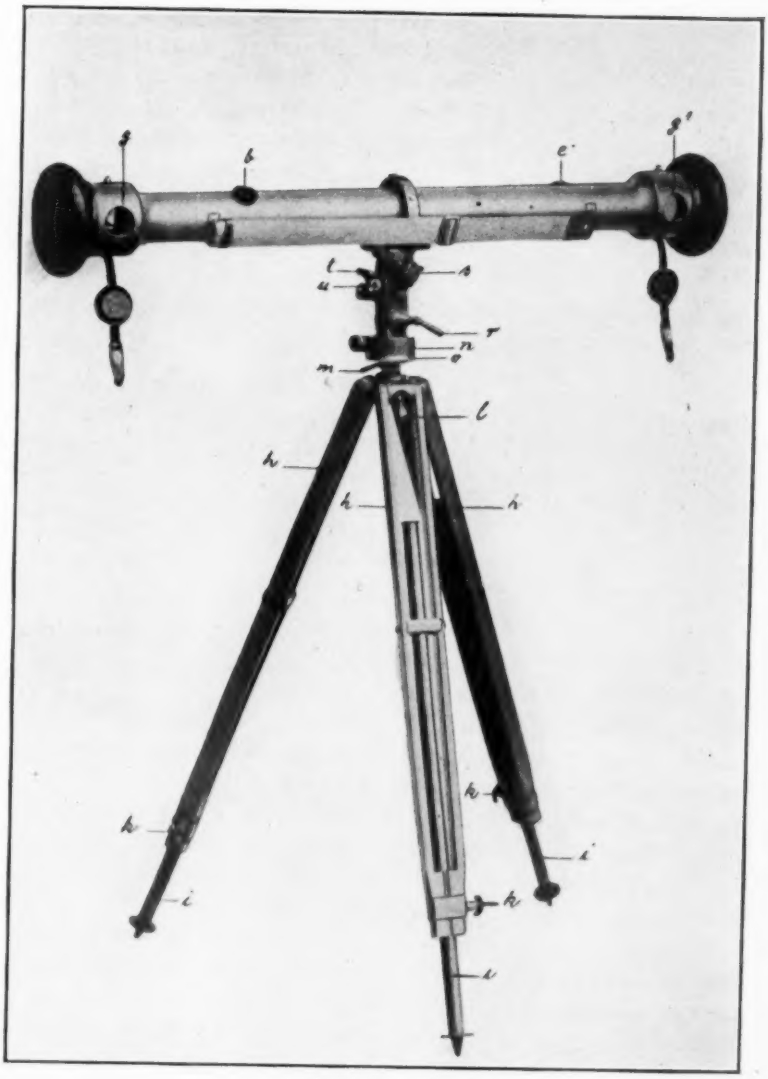

FIGURE 2.

Average errors in setting under favorable conditions:

Distances	*Errors in Setting*	*Distances*	*Errors in Setting*
600 meters	1.2 meters	3000 meters	29 meters
700 meters	1.5 meters	4000 meters	52 meters
800 meters	2.1 meters	5000 meters	81 meters
900 meters	2.6 meters	6000 meters	116 meters
1000 meters	3.2 meters	7000 meters	158 meters
1500 meters	7.5 meters	8000 meters	207 meters
2000 meters	13.0 meters		

The tolerances, within which the measurements are in practical use, are three times as large.

	Weights.	
Range finder	8.35 kilograms	18.37 pounds
Adjusting bar	1.9 kilograms	4.18 pounds
Tripod	6.6 kilograms	14.52 pounds
Storage Box	28.6 kilograms	62.92 pounds

INSTRUCTIONS.

1. Assembling.

Hold the tripod by the head; loosen locking screws "k" and permit leg extensions "i" to drop out; then tighten locking screws "k"; spread legs so that tripod head is nearly horizontal and then press locking lever "l" upward.

Take range finder from box, with eye-piece turned towards body, fastening hook pointing downwardly, slanting from left to right, push the hook "w" over bolt "x" of the tripod head and turn range finder downwardly with the left end until the hooking-bolt "y" snaps into the locking part of the tripod-head. The instrument is then seated firmly on the tripod.

Remove protective hoods from eye-piece and entrance apertures, putting on the sun-screen, if necessary. Loosen locking lever "m," turn range finder towards the target and fasten locking lever "m." Loosen locking lever "r," turn range finder so that its longitudinal axis is horizontal and then fasten locking lever "r."

2. Dismounting.

This is accomplished in reversed order from the one described above.

If necessary the colored glass and sun screens are removed from the range finder and eye-piece and entrance apertures covered with

the protective hoods. Then push the locking head "z" to the right and the right hand end of range finder downwardly to release hooking bolt "y" from its recess, lift the range finder from tripod and replace in box.

The three locking levers "l," on the tripod head are pressed down, lift tripod, head down loosen locking screws "k" and permit the tubular extensions "i" to drop back between wooden bars and relock levers "k," replacing tripod in box.

3. Measuring Distances.

Before beginning to measure, the eye-piece is set for the visual distance of the observer by means of the diopter scale. If the dis-

FIGURE 3.

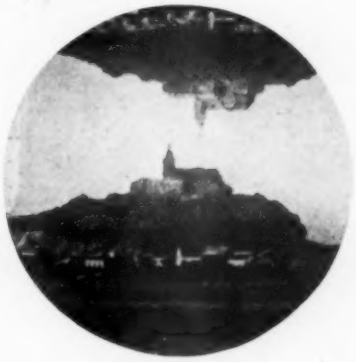

FIGURE 4.

tance be unknown to him, the eye-piece is set by turning until the image of a far distant object with the greatest possible amount of details, such as walls, bushes, frameworks, and the like, appears absolutely sharply defined. The resulting number of the diopter scale must then be memorized.

In harsh light or heavy haze in the distance the orange or yellow screen, as required, is to be used on the eye-piece.

The range finder having been coarsely set at the target, if necessary by means of the finder, the object is looked for in the field of view. Lateral setting is accomplished by turning the range finder on the tripod pivot after loosening the locking lever "m." For use against stationary targets this lever is relocked after the range finder has been properly set. The adjustment for height is affected by means of adjusting screw "s."

The range finder's field of view is divided into two parts by a horizontal line. In the lower part of the image of the object appears upright, and in the upper part inverted (Fig. 3).

By turning the height adjustment screw "s" the images are lined up so that the proper points will touch the dividing line (Fig. 4).

By turning the measuring screw "b" the image is shifted laterally until the same vertical rim or similar points of the object are laterally exactly above one another (Fig. 5). The distance is then read on the distance scale "c."

With laterally moving targets, it is best to adjust the images on

FIGURE 5.

the edge of the field of view corresponding to the direction of the movement and make the measurement while the image runs through the field.

With targets which have no prominent vertical lines or points, but show horizontal lines, such as tops of heights, entrenchments, and the like, the distance is measured on the horizontal line by setting the instrument vertical (Fig. 6). For this purpose locking lever "r" is loosened, the range finder turned down on the left, and the lever tightened. If the rotating plane was not vertical to get the range finder perfectly vertical the locking lever "v" is loosened, the instrument set exactly perpendicular and lever "v" again tightened. Measurements are taken in the same manner as described above. The image first appears as illustrated in Fig. 7. By turning the measuring screw the partial images are shifted so that the horizontal line is continued exactly on the dividing line (Fig. 8). Errors in height of the instrument (see 4a) prejudice the exact-

ness in measuring, if the line is sighted at does not run exactly horizontal.

Making Corrections.

There are two kinds:

(a) Correction for height.

(b) Correction for distance.

a. Correction for Height.

A shifting of the partial images as to height is apparent, when, in sighting at an object, they do not touch the dividing line with similar points, so that one image reaches the dividing line before the other (see Fig. 9). To eliminate such an error, the range finder must be trained at an object having a sharply defined horizontal line or particularly prominent point, the images are brought laterally exactly opposite each other by means of the measuring screw. The height correction screw is then loosened, and the clearly defined line or prominent point is pushed against the dividing line, using therefor

FIGURE 6.

FIGURE 7.

FIGURE 8.

FIGURE 9.

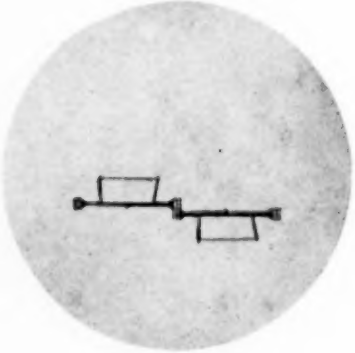

FIGURE 10.

the height adjustment wheel in the lower image and the height correction screw in the upper one. Then secure the height correction screw against accidental or unauthouized shifting by placing the protective cap over it.

b. Correction for Distance.

It is advisable to test the range finder from time to time as to its precision in measuring, as otherwise trifling errors in measuring could not be observed.

The examination and adjustment are made with the adjusting bar. The method consists in examining the setting of the distance scale ∞. The object at the universal distance, from which the parallel pencil of rays would go to the two entrance apertures, is

replaced by the adjusting bar, whose parallel bundles of rays fall into the two entrance openings.

The adjustment bar is set up at some distance—not less than 100 meters—from the rangefinder, and parallel to it. The lines on the adjusting bar are than brought to coincide laterally, as shown in Fig. 10, by means of the measuring screw, and the distance index must then point at ∞.

If this is not the case, the measuring screw should be turned several times and this proceeding repeated several times for purposes of verification. If during this procedure an error should remain consistently, the distance scale is set at ∞, the protection of the distance correction screw is removed after having turned the locking screw, and the two lines are adjusted laterally exactly with the correction screw, as in Fig. 10.

On account of the importance of having a precise adjustment, it is advisable to make several adjustments, to read the position of the correction screw each time and for making the correction set at the mean of the several readings. This average should be memorized for future examinations. This accomplished, the protective cap for the correction screw must be closed and secured with the locking screw to prevent unintentional disarrangement.

5. Care of the Rangefinder.

The solid construction of the instrument makes it strong enough to withstand the normal strain of the usual use in the field. Nevertheless, like other instruments of precision, it should be handled with ordinary care so that it will always work with the required exactness. All undue throwing of knocking must be avoided.

The instrument after use, must always be replaced in the storage box. This must never be stored in the immediate vicinity of a hot stove, in winter, nor be exposed to extreme cold, or to extreme heat from the sun in summer.

If the instrument becomes wet or soiled during use, it should be cleaned with a soft linen rag. The exterior glass surfaces should be carefully wiped with the leather rag, without much rubbing.

Dry dust is removed with the hair brush.

The instrument is closed so tightly that dust and moisture cannot penetrate into the interior.

All work on the range finder, such as unnecessary turning of screws, and the like, not incident to its use or cleaning, must be strictly forbidden.

THE EFFECT OF LOST MOTION ON ACCURACY.

By 1st Lieutenant Raphael R. Nix, Coast Artillery Corps.

Lost motion to the amount of 8 or 10 mils in the elevating and traversing mechanisms of the service 3-inch gun carriages does not materially affect their accuracy. An exaggerated idea of its effect subjects the 3-inch matériel to unjust adverse criticism among battery commanders of the Field Artillery and offers an easy explanation for erratic results which should properly be traced to other causes.

Play in sights, lost motion and slipping of range discs of quadrants, and errors due to the use of improper range rings—although such errors might appear on firing records as due to lost motion were they not traced to their proper sources—are not considered. Moreover, the effect that lost motion has on the rapidity of firing is only briefly mentioned because, as indicated hereafter and as shown by a little experience, it is a matter of no large importance. One turn of the traversing hand-wheel of the 3-inch gun carriage corresponds to about 12 mils lost motion and one turn of the elevating crank to about 18 mils, whereas the maximum amount of lost motion to be expected in these parts after severe use is 11 and 9 mils respectively. As a rule, less than a half turn of the hand-wheels will cause motion to be imparted to the gun.

Analysis will be made of the derangement of the piece and flight of the projectile due to lost motion in the gun carriage (a) during the usual operations performed by the gun squads in service firing and (b) during the time of flight of the projectile in the bore of the gun.

Deductions will be drawn from this analysis as well as from a study of service and proof firings.

A consideration of the duties performed by the gun squad in firing the piece is of the highest importance to show that if the cannoneers perform their functions properly, especially the gunner and No. 1 who control the gun, there is little possibility of throwing the piece materially off the line of sight before firing. The preliminary operations of shifting the trail, opening the breech, entering the projectile, and closing the breech having been performed, the piece is accurately directed by two operations: No. 1 centering the bubble of the range level of the quadrant and calling "Set," and the gunner placing the

vertical cross hair of the panoramic sight on the aiming point and calling "Ready." (With direct fire the gunner lays for both range and direction.) No matter how rapid the fire, the direction of the piece is never assumed to be correct but is verified immediately before the final operation of pulling down on the firing handle. After the reports, "Set" and "Ready," the gun should be accurately laid for the command, "Fire." No. 1 then pulls down sharply on the firing handle. This is the final operation of the gun crew and the only one which permits an error due to lost motion to enter the results. Just how small this error is, will appear later.

At this juncture special emphasis is laid on the fact that the panoramic sight and elevation quadrant are both attached to the cradle and since there is practically no play between the cradle and the gun, the slightest changes of the gun from the line of sight are immediately registered in the eye piece of the panoramic sight and on the bubble of the quadrant. The gunner, moreover, has a ready check under his eye on the azimuth scale of the carriage to see clearly whether the piece through any possible cause has been jarred off its correct position. The lost motion in the gun carriage does not alter in any way this registering of the gun's direction. There is, therefore, no excuse for claiming that after the gun had been laid it settled down or slipped sidewise off the line of direction as such errors were immediately registered and should have been detected and corrected at once.

The possible derangement of the gun in maneuvering it into position and derangements which occur due to the settling or slipping of the gun through the limits of play or lost motion in the elevating and traverisng gears, as well as the amount the gun is jarred from its correct position in the final operation of firing—all these may be accurately measured. For these measurements the carriage selected had 8 mils lost motion in azimuth and 6 in elevation. With the Model of 1905 gun (lighter than the Model of 1902) and the Model of 1905 breech mechanism, greater derangements occurred than with the Model of 1902 type. Experiments are, therefore, given with the former gun and carriage. The results below are true whether the

wheels of the vehicle are horizontal or one elevated as much as 15 inches above the other:

Range, Yards	Effect on the Deflection in Opening the Breech. Gun not Loaded. No Effect in Elevation.	Effect on the Elevation by Loading—No Effect Observed in Deflection.	Effect on the Deflection in Closing the Breech Gun Loaded. No Effect on the Elevation.
1500	7 mils	0 mils	1 mil
1900	7 mils	1 mil	1 mil
2300	7½ mils	2 mils	1.2 mils
2700	7½ mils	1 mil	1.5 mils
3500	7 mils	0 mils	1 mil
4600	7 mils	0 mils	1 mil

The operations above were performed smartly, exercising as much force as possible by hand. Whether the piece was elevated or depressed to the range given, there was no change noted beyond the one shown in the table. The results are practically the same whether the operations are performed deliberately or rapidly.

The final operation of pulling down on the firing handle with the gun loaded is the only one, as emphasized before, which permits an error due to lost motion to enter the results. A fine distinction might be made here in this final operation between the derangement of the piece up to the time the projectile leaves the bore, which is caused only by pressure downward on the firing handle sufficient to trip the firing pin, and the total derangement of the piece caused not only by tripping the firing pin but also by the force required to trip the firing pallet together with the shock on the cradle at the end of the downward motion of the hand. As the results are small for convenience the total derangement of the piece is given—

At 0 range up to 1500 yards, the effect is 0, as the excessive preponderance at the *muzzle* is such that no downward force on the firing handle exerted by hand overcomes this preponderance and friction.

At ranges 1500 to 1900 yards the effect in elevation is 0 to 2½ mils.

At the range 1900 yards the effect is about the maximum—2, 2½, or 3 mils.

At ranges 1900 to 2400 yards, effect 3 to 1½ mils.

At ranges 2500 to 3000 yards, effect 1½ to 0 miles.

At ranges 3000 yards and above, the effect is 0, as the excessive preponderance of the *breech* takes up the lost motion so that no downward force applied by hand on the firing handle deranges the gun.

With the 1902 and 1904 Model of gun and breech mechanism the trigger alone is tripped in the act of firing—no extra pressure being required to trip a firing pallet. No derangement occurs in the elevation up to the time of firing; the trigger and the final shock on the cradle at the end of the downward jerk of the hand gives deviations less than those recorded above for the Model of 1905 gun and breech mechanism. These measurements were taken without actually firing the gun as the effects could be determined better in this way. When the gun is fired the downward motion of the hand on the firing handle is accelerated by the shock of discharge and the final blow on the cradle is practically the same whether one or the other model is used; but as this blow occurs after the projectile leaves the bore, it does not affect the accuracy of firing. The figure 3 mils is, therefore, far greater than any effect on the elevation of the piece which might be attributed to firing it by the firing handle. It must be noted that no derangement whatever occurs in the azimuth of the piece; in fact about 35 or 40 pounds straight side pull is required to shift the gun in azimuth. This means that the gunner, simply leaning against the shoulder guard, will not derange the gun, but that a conscious effort on his part is necessary. Firing by lanyard produces practically no derangement in the azimuth or in the elevation.

By means of an example we may illustrate the behavior of the piece in the hands of service gun squads and thereby indicate the negligible effect lost motion has in practice

The regular gun squad of Carriage 92, Battery "F," 6th F. A. was used and subcaliber ammunition was fired. Carriage 92 was selected because the lost motion in it was practically as great as that of any in the regiment—9 mils both in azimuth and in elevation. Usual commands were given for indirect laying and usual operations performed by the gun squad, the members having been cautioned to neglect any conscious effort to take up lost motion by such means as bearing the shoulder against the shoulder guard or taking up the play in the elevating crank. A target 5 feet high and 8 inches wide was placed 72 yards away; an aiming point was selected; and four shots were fired.

The four shots were grouped so that the maximum absolute deviation of them from one another was 1.3 inches.

Seven more shots were fired with the same data except that after each shot (as for all other shots which follow) the piece was run con-

siderably off its direction, necessitating separate and rapid laying at each round.

The result was that all eleven shots were grouped within a circle with a radius of 1.2 mils.

Four more shots were fired using the above firing data with the angle of site changed from 260 to 263 for the purpose of obtaining another group higher on the target. All these four missed the target. Had any one or two of them struck the target and the dispersion been great, the result may have been attributed with some reason to lost motion. But the fact that the whole group missed and further that the next four shots were fired on the identical data giving an excellent target, discredits any claim that lost motion effected the result.

The pattern of the next four shots which were fired on this same data showed the greatest distance apart of any holes in elevation less than 1 inch and in azimuth less than 2 inches. The angle of site was then raised to 266, and four more shots fired.

The greatest distance apart of the perforations of this series in elevation was 2 inches, in azimuth, 1½ inches.

The range setting on the quadrant for all these shots was 2,500 yards.

The result of this firing may well be expressed in the words of the battery commander, "If my guns fire like this, I have no complaint to register against lost motion."

As subcaliber ammunition was used in the above test, the question naturally arises whether lost motion in the traversing and elevating mechanisms subjects the piece to derangements at the shock of discharge of service ammunition while the projectile is still in the bore. For the entirely practical mind it may be stated at once that tests have been conducted at the Sandy Hook Proving Ground, N. J., in which the 3-inch gun was discharged with the elevating and traversing mechanisms removed so that the "jump" of the gun was not restrained, and only the normal jump of 6 or 7 minutes was obtained. Moreover, the nature of the platform, shifting of the trail during recoil, and firing over parapets, and so forth did not affect the jump. For those who care to indulge in a theoretical investigation of this subject, it may be of interest to follow the line of thought which offered itself, in the absence of available firing data, as circumstantial—far from conclusive—evidence against attributing inaccuracies of fire to lost motion in the mechanisms. Since the

firing test proves or disproves theory by a remarkably accurate and rapid demonstration of the facts, this discussion may be credited with logical assumptions and deductions in so far as it predicted what actually occurred later in the experiments at Sandy Hook.

The question that first presents itself is whether the gun and recoiling parts move sufficiently to the rear at firing up to the time the projectile clears the muzzle to justify the belief that material relative displacements occur which derange the longitudinal axis of the bore and influence the flight of the projectile. (Slide rule used for computations.)

For free recoil—

x is the distance passed over by the recoiling parts.

V_g is the velocity of the recoiling parts.

V_p is the velocity of the projectile, 1,700 feet per second.

W_g is the weight of the recoiling parts; this includes the weight of the gun, 835 pounds; plus the cylinder, 50 pounds; plus the oil, 8 pounds; plus the weight of a few end coils of the spring column, this last weight being neglected. The distinction is regarded here between the action of springs under slow compression and their action under rapid compression. It is usual to assume that the center of gravity of a spring column moves through one half the distance that the end coil is displaced. For rapid compression, as in this case, however, experiment indicates that in the initial stages of recoil the end coils upon which the pressure is applied collapse, and the shock of recoil is transmitted in a wave-like motion of solid coils down the spring column. For instance during firings with a void in the cylinder corresponding to two pints of oil removed the acceleration of these solid coils against the cradle rear ends was so great as to bulge new cradle rear ends in a few rounds, the springs in no case becoming solid, but exerting a far greater effect than their load at solid height. So few coils take up this acceleration to the time the projectile leaves the bore that their weight may be disregarded.

$\overline{w}$ is the weight of the powder charge, 24.25 ounces.

w_p is the weight of the projectile, 15 pounds.

Y is the travel of the projectile, 6.21 feet.

These symbols in the following formula express a relation which agrees very closely with the results of experiments simulating free recoil.

$V_g W_g = (W_p + \frac{\overline{w}}{2}) V_p$ . . . Equation (1); or expressing by a differential equation:

$$\frac{dx}{dt} W_g = (W_p + \frac{\overline{w}}{2}) \frac{dy}{dt}.$$

Integrating and—

$$xW_g = (W_p + \frac{\overline{w}}{2}) Y.$$

Then by substituting values—

$$893x = (15 + \frac{24.25}{32}) 6.21 \text{ or,}$$

$$x = 1.3164 \text{ inches.}$$

To determine what distance will be passed over in retarded recoil it will be necessary to get the approximate time the projectile is in the bore. A differential equation expressing—Retardation = Mass × Acceleration, may then be integrated and the recoil due to retardation subtracted from the free recoil.

By assuming that the velocity of the projectile as a function of the time varies as the abscissas and ordinates of a common parabola, and using the usual symbols to express velocity, distance, etc.,

$\frac{du}{dt} = V = \sqrt{2pt}$ . . . (a); or, $V\ dt = \sqrt{2pt}\ dt$, and $\int V dt = \int \frac{du}{dt} dt =$

$u = \int \sqrt{2pt}\ dt = \frac{2}{3}(2p)^{\frac{1}{2}} t^{\frac{3}{2}}$; and from (a) $\sqrt{2p} = \frac{V}{\sqrt{t}}$. $\therefore u = \frac{2}{3}(\frac{V}{t^{\frac{1}{2}}}) t^{\frac{3}{2}} = \frac{2}{3} Vt$

or $t = \frac{3}{2} \frac{U}{V}$.

U, the travel, $= 6.21$ feet and V, the muzzle velocity, $= 1700$ feet seconds. So that "t" $= .00548$ seconds.

The least time of flight of the projectile in the bore may be determined by assuming that the projectile leaves the bore without resistance actuated over the full travel by the maximum powder pressure.

$\frac{15}{32.2} \frac{d^2x}{dt^2} = \frac{33000\ \pi\ 3^2}{4}$ which by integration and substitution of $x = 6.21$ gives $t = .005$ second.

By way of comparison the least mean constant force of the explosion acting over the travel is one which gives a muzzle velocity of 1700 foot-seconds. So that $\frac{15}{32.2} \times \frac{1700^2}{2} = P \times 6.21$, or $P = 109{,}500$ pounds.

Expressing the differential equation of motion of the projectile, $109{,}500 = \frac{15}{32.2}\frac{d^2x}{dt^2}$, or on integration and substitution, $t = .007$ second.

It appears that $t < .007$ and $> .005$.

As the first value deduced falls between these two limits and is a close approximation "t" is taken as .0055.

In the design of the carriage the resistance opposed to recoil during the time the powder gases act on the gun is constant and equal to 4923 pounds. This is a satisfactorily close value which has been verified by experiment. It is calculated from the spring, friction, and oil resistance. Experiment has proved that the oil resistance is by far the governing factor; for with the present design of cylinder and piston head the springs and friction could be neglected altogether without materially affecting the length of recoil, as the additional resistance offered by the springs and friction would be accommodated by a corresponding increase in the oil pressure. The oil pressure starts to act instantly with a full cylinder but with a void in the cylinder the pressure does not rise till the stroke of the piston banks all the oil in a solid column in rear of it, and then the pressure shoots up simultaneously to a greater height than normal. Thus firings have been had with 2 pints of oil removed from the cylinder (the full cylinder holds 9½ pints of oil) and no pressure in the cylinder was recorded over a distance corresponding to a void of 2 pints, but the pressure immediately arose over the remaining recoil to a large and practically even height so that the work done was the same as that in a normal cylinder and the length of recoil also the same—44 inches. Incidentally it might be mentioned that a very slight increase in the throttling orifice does materially affect the length of reco l for .01 square inch more clearance produces about 1 inch more recoil. In the full cylinder the value 4923 pounds can, therefore, be assumed with confidence.

For recoiling parts the negative acceleration equals—

$$\frac{d^2x}{dt^2} = -\frac{4923}{\frac{893}{32.2}}; \quad x = -\tfrac{1}{2}\frac{4923}{\frac{893}{32.2}}\,t^2, \text{ or } x = -.03204 \text{ inch.}$$

So that the distance passed over in retarded recoil equals—

1.3164 inch $-$ .03204 inch, or 1.2844 inches.

The gun moves to the rear about 1.3 inches by the time the projectile clears the muzzle; this indicates that the investigation must be

carried further to determine other motions of the gun and carriage which produce derangements of the longitudinal axis of the bore. To all practical purposes the distance recoiled by the gun on the cradle guides in retarded recoil (1.2844 inches) is equal to the distance of free recoil (1.3164 inches). For this reason if the force producing rotation of the gun about its center of gravity and of the cradle about the pintle is sufficiently large, it appears at once that this rotation will be comparatively free over the short period of time considered and produce a measurable deviation in the flight of the projectile. The proposition relevant to the subject of lost motion is to determine how much deviation will occur and whether all of this can be accommodated by necessary tolerances, elasticity and flexibility of parts, and relative give and take of the parts among themselves.

Formulae for the moments of inertia of the gun and cradle will first be deduced and then equations of rotation of these parts solved.

The polar moment of inertia of a circular section, $=\pi r^2\frac{r^2}{2}$; the moment of inertia about either horizontal or vertical axis, $=\pi r^2\frac{r^2}{4}$.

Then if the section be hollow,

$$\Sigma\, mr^2 = \frac{A_1 R^2}{4} - \frac{A_2 r^2}{4}.$$

If this section is expanded into a hollow cylinder the moment of inertia of an infinitely thin slice about a horizontal axis at a distance "1" equals,

$$\frac{A_1 R^2}{4} - \frac{A_2 r^2}{4} + (A_1 - A_2)1^2;$$

and for all such slices,

$$\int_0^1 \left[\left(\frac{A_1 R^2}{4} - \frac{A_2 r^2}{4}\right) d1 + (A_1 - A_2)1^2 d1 \right]$$

$$= \frac{1}{4}(M_1 R^2 - M_2 r^2) + \frac{1}{3}1^2(M_1 - M_2) \quad . \quad . \quad . \quad \text{Eq. (2).}$$

where 1 equals one-half the length; M_1, the mass of a solid cylinder with a radius R; and M_2, the mass of a solid cylinder with a radius r.

Equation (2) will be used for the gun.

For the cradle—

The area of the cross section equals 5.61 square inches. The moment of inertia of this section about a horizontal axis through its center of gravity as determined by taking the sum of the moments of inertia

of small symmetrical figures composing the area is 29.236. Therefore k^2 equals 5.23; and for a horizontal axis through the center of gravity of the cradle at a distance 1,

$$\int_0^1 (Ak^2 d1 + A1^2 d1) = Ak^2 1 + \frac{1}{3} A1^3 = M(k^2 + \frac{1^2}{3}) \quad . \quad . \quad . \quad \text{Eq. (3).}$$

Equation (3) will be used for the cradle.

For the gun about its longitudinal axis,

$$\frac{m}{M} = \frac{2\pi \times dx}{\pi(R^2 - r^2)}$$

or

$$m = \frac{2M \times dx}{R^2 - r^2}; \quad \Sigma mr^2 = \frac{2M}{R^2 - r^2} \int_r^R x^3 dx = \frac{M}{2} (R^2 + r^2) \quad . \quad . \quad . \quad \text{Eq. (4)}$$

where M is the mass of a hollow cylinder with radii R and r.

Equation (4) will be used to discuss the effect of the rifling.

The gun is considered as built of three hollow cylinders with the dimensions given below,

(a) $R = 4$ inches; $r = 1.5$ inches; $1 = \frac{25}{2}$ inches, as the jacket and tube length taken equals 25 inches. 1_1 equals the distance of the center of gravity of this cylinder to the center of gravity of the whole three or to the center of gravity of the gun, $= 25$ inches.

(b) $R = 3.8$ inches; $r = 1.5$ inches; 1, for this cylinder, $= \frac{29.8}{2}$ inches; 1_1 in this case $= 2.25$ inches.

(c) $R = 2.9$ inches; $r = 1.5$ inches; 1, for this cylinder, $= \frac{35}{2}$ inches 1_1 in this case $= 34$ inches.

The moment of inertia of these component cylinders about the horizontal axis through the center of gravity of the gun may be obtained by substituting the values given above in Equation (2), and adding the term, $(M_1 - M_2)1_1^2$. This gives under (a), 45.9; (b), 5.87; (c), 53.33. So that the moment of inertia of the three cylinders or gun about the horizontal axis through its center of gravity is $45.9 + 5.87 + 53.33 = 105$. So that $Mk^2 = 105$, and $k = 2.015$ feet.

This value of the radius of gyration is sufficiently close, as for a gun of this type it may be assumed to be equal to one-fourth the length of the gun; in this case, 1.83 feet.

For the cradle, substitute in Equation (3) $M = \frac{180}{32.2}$; $k^2 = \frac{5.23}{144}$;

$1=\frac{79.625}{24}$; $1_1=\frac{12}{12}$, the distance of the center of gravity of the cradle to the axis of rotation about the pintle. Add as above the term $M1_1^2$ to reduce the moment of inertia from the horizontal axis through the center of gravity of the cradle to the horizontal axis through the center of gravity of the pintle and the result is 26.33.

The rotation of the gun about its center of gravity is due to the moment of a large force at the cylinder end stud.

The force along the piston rod may be considered as 4923 pounds as explained before. To this force should be added the force due to the fact that the cylinder is being drawn to the rear with the same acceleration as the gun. Assuming the maximum effect possible,

The force is $33{,}000\times\frac{\pi r^2}{4}$, or 233,264 pounds.

With this force acting on the recoiling parts, the acceleration equals,

$$\frac{d^2x}{dt^2}=233{,}264\times\frac{32.2}{895}=8370\ \frac{\text{foot.}}{\text{seconds seconds}}.$$

Now reducing all moments acting to the lever-arm 7.156 inches (the distance of the center of gravity of the gun to the center of gravity of the cylinder),

The moment of the cylinder and oil $(\frac{60}{32.2}\times8370\times\frac{7.156}{12})$ plus the moment of the gun lug, clips, and adjacent metal $(\frac{15.86}{32.2}\times8370\times\frac{7.156}{12})$ plus the moment of the piston rod pull $(4923\times\frac{7.156}{12})=105\frac{d^2\phi}{dt^2}$; whence, $\phi=7.26$ minutes, the angular "jump" of the *gun* while the projectile is in the bore.

This rotation of the gun about its spontaneous axis (horizontal axis through the center of gravity perpendicular to the longitudinal axis) gives an upward whip to and effects the "jump" of the *projectile*. The distance from the center of gravity of the gun to the muzzle is 4.33 feet. So that the velocity of the projectile perpendicular to the bore as it leaves the muzzle is, $\frac{d\phi}{dt}\times4.33$, and the angle of jump due to this cause,

$$\tan\ \frac{\frac{d\phi}{dt}\times4.33}{1700}=6.74 \text{ minutes.}$$

Therefore, with the gun in free motion actuated by the maximum powder pressure, the jump of the projectile might measure 6.74+7.26 minutes.

Does the rotation of the cradle retard or accelerate this rotation of the gun?

Simultaneous with the rotation of the gun the cradle is being pulled about the cradle pintle by the force along the piston rod. The immediacy of its angular motion depends on the elevation of the piece, etc., to allow an instantaneous pivot effect. The cylinder and springs taking up the acceleration of the gun to the extent previously discussed are free to respond to any relatively small changes in the angle between the gun and the cradle without binding or setting up appreciable forces against the rotation of either. Since the lever of the piston rod pull over the cradle pintle is 5.7 inches,

$$4923\times\frac{5.7}{12}=26.33\ \frac{d^2\psi}{dt^2};\ \psi=4.6 \text{ minutes},$$

the angle of rotation of the cradle about its pintle.

During the two simultaneous motions discussed—the gun recoiling and rotating about its spontaneous axis and the cradle rotating about its pintle—one follows the motion of the other closely so that there is perhaps always play between the cradle guides and the gun clips, the cradle retarding the gun very slightly if any at all; moreover, as the angular motion, even under the extreme assumption of maximum powder pressure acting during the entire period, is so small (about 7 minutes for the gun, and 5 minutes for the cradle) it appears that there is sufficient elasticity in the parts of the carriage to accommodate this rotation without introducing large strains in the gun clips, cradle guides, or elevating mechanisms.

It is at once seen that the rotation of parts about the spade edge or the failure of the trail to hold have infinitely less effects than the propositions investigated.

It might be imagined that the rotation of the projectile in the bore affects the deflection, as the gun is eccentrically attached by the gun lug to the cylinder.

The average effective pressure producing angular acceleration of the projectile tends also to rotate the gun about its longitudinal axis. k^2 for the projectile $=\frac{r^2}{2}=\frac{1}{128}$. The angular velocity of the projectile,

$\frac{d\beta}{dt}=\frac{1700\times 2\pi}{25\times \frac{1}{4}}=1700$ radians per second, the twist at the muzzle being $\frac{1}{25}$.

p = the normal pressure on a groove; $a=\tan^{-1}\frac{\pi}{n}$, the angle of the rifling; $n=25$, since there is one turn in 25 calibers at the muzzle; $r=\frac{1}{8}$, the radius of the projectile; $f=.15$, the coefficient of friction between the copper band and the steel rifling; $t=.0055$ as before; $M=\frac{15}{32.2}$ as before. The equation of rotation of the projectile is,

$$p\cos ar-pf\sin ar=Fr=Mk^2\frac{d^2\beta}{dt^2} \quad . \quad . \quad . \quad \text{Eq. (A)}$$

By substituting the above values in Equation (A), $p=9360$ pounds. The average effective pressure, $F=9360\cos a-9369f\sin a=9100$ pounds.

For the effect of this pressure on rotating the gun—From Equation (4) $Mk^2=\frac{M}{2}(R^2+r^2)$ which by substitution gives the value of Mk^2 for the gun about its longitudinal axis, $1.428\therefore F\times\frac{1}{8}=1.428\frac{d^2\delta}{dt^2}$ or $\delta=42.4$ minutes as the angle through which the gun would rotate freely about its longitudinal axis while the projectile is in the bore. Then the displacement of any particle of the gun clips at the breech end with reference to the cradle guides equals .045 inches.

If the breech end of the gun were thrown off in deflection this whole amount the error would be negligible.

Firing records are susceptible of intelligent analysis to determine the behavior of the piece as regards lost motion. It would appear that irregular heights of bursts, cross fires and the like would be especially prevalent in cases where carriages having considerable lost motion are used. In numerous reports examined the most remarkable feature therein was the absence of such irregularities and the high accuracy with which the pieces responded to the laying. This was especially noticeable in salvo firing. The absence of such irregularities is a more positive proof that lost motion does not affect the accuracy than the presence of irregularities, a proof that it does.

Investigation of the sources of errors which might be attributed

off-hand to lost motion should be encouraged by battery commanders. The following examples are taken from a report of one inspection made from the Rock Island Arsenal in 1913.

(1) Bracket fuze setter 882, Battery D, 6th F. A., had "Erhardt 1911" range ring assembled thereon; the reverse side of the ring should have been assembled up. (2) Bracket fuze setters 336, 439, 1124, and 1125 of Battery B, 6th F. A., had incorrect range rings assembled thereon. (3) Panoramic sight 611, Battery A, 6th F. A., had 15 mils lost motion in the rotating head. (4) Quadrant of Carriage 74, Battery F, 6th F. A. had the range disc slip 20 mils during the firing in October, 1913. (5) Quadrant 465, Battery A, Colorado National Guard, had 7 mils lost motion in the level micrometer disc.

As a result of this investigation it is believed that the following deductions may be drawn—

(1) Lost motion in the traversing and elevating mechanisms of the 3-inch gun carriage does not affect its accuracy materially. The measured effect proves to be a maximum at ranges between 1500 and 2500 yards where the effect is in elevation alone and may approximate 3 mils; this is more than compensated for by the dispersion of the shrapnel balls.

(2) In the heat of action and with poorly trained gun detachments it must be realized that the operations of firing might be reversed—the gun directed and then loaded and fired without verifying the laying. In this case errors to the amount of 3 mils in elevation and 3 to 5 mils in azimuth are possible. In the excitement of the moment the gun may be jolted off the target in azimuth (this requires considerable force, about 30 or 40 pounds, not merely leaning against the gun) after the piece has been loaded and directed. These are exceptional cases that are possible only under conditions of intense excitement, too great haste, and with poorly disciplined gun squads.

As a matter of policy it is the intention of the Ordnance Department to eliminate lost motion as far as practicable, and to this end parts of the traversing mechanism in which most of the wear occurs have been made of case hardened steel, of a high grade bronze, and with spring components to take up automatically the lost motion and so forth. Carriages equipped with these parts have been undergoing tests for the past six months on the Mexican border with the view of developing the most satisfactory means to correct the difficulty.

THE ARTILLERY COLLAR.

By 1st. Lieutenant Harry Pfeil, 1st Field Artillery.

In an article appearing in the July-September, 1914, issue of the Field Artillery Journal, entitled "Mobilization of a French Garrison," the writer of the article, under the heading, "Incidents of the Mobilization," has noted the following: "No officer supervised the fitting of the harness in the ——th battery. On account of the simplicity of the harness this was done properly and quickly by the drivers themselves. With our steel collars it would have been very difficult, if not impossible, to have harnessed some of the horses that were received at ——."

The battery here spoken of was mobilized in a few hours. The additional horses were delivered at midnight, and at daylight the battery was ready to proceed wherever directed. If, as has been stated in the excerpt above, this organization had been equipped with a collar similar to ours, even if collars sufficient to equip the animals had been on hand, the time consumed would have been much greater, and in the end it would have been necessary to move out with some horses wearing collars that shortly would produce sores and galls and render the animals worthless for draft.

Our collar so far has never been a source of great worriment, simply because it has never been given a fair chance to do its worst. In the marches that we make in times of peace, our horses are handled and babied to an extent that in time of war will be impracticable. While it is not meant to imply that the horse should be neglected, it is not impossible to conceive of conditions arising which will make the treatment that the animal does get compared to what it has formerly received in garrison appear in the light of the most wanton neglect. And still it may be the best that circumstances will permit of. As an example, it is a recognized fact and so stated in our drill regulations that animals may be expected to fall off in weight on the march. Not only is there a chance of it, but it can be set down as a certainty that they will. This happens under the very best conditions, where forage is plentiful and regularly fed, often in increased quantities compared to that which the same animals thrive on in garrison. It is a pretty poor stable sergeant who cannot make a saving of grain in garrison and still keep his

horses in the pink of condition for drill purposes. Nor must the exhaustion of the men be overlooked. They will not look after their teams with the same zest in war times as in times of peace, and the officers will not require them to do so. There will be very little hand-rubbing, pickling of backs and shoulders, and so forth, such as aid in preserving the horse's condition in a high state of efficiency. A horse loses weight around the neck and shoulders very quickly, so that after a day or two on the road necks will be too small for collars that may previously have been perfectly suited to the horse; and unless the collar can be readjusted galls and sores will appear, and in a few days more the horse's usefulness in the team will vanish.

But besides this, there will be horses that from the start were not properly fitted. Such animals will give trouble before they have had a chance to fall away in weight to any appreciable extent, and if it was impossible to fit them satisfactorily before leaving the garrison, there will be small chance of doing so from the supply of spare collars in the battery wagon, if there are any spare collars at all.

Furthermore, we must figure on collars becoming unserviceable. When they do, they must be sent back to the manufacturer for repairs and requisition for others submitted. The result of this is bound to be confusion, and in many cases one may expect to find 6's and 7's where 4-A's would do much better!

Now let us consider the subject from another angle. Let us rate the efficiency of the steel collar when properly adjusted and perfectly fitted at 100 per cent. as compared to any known substitute which we will rate at 75 per cent. It is easily conceivable that the efficiency of the steel collar which under favorable conditions gives the maximum may be reduced to 50 per cent. and even as low as zero, due to unavoidable causes. Wouldn't it seem more reasonable, therefore, to accept a 75 per cent. efficiency which can almost surely be maintained than to gamble on a 100 per cent. efficiency with more than an even chance that it will reduce to 50 per cent. or less? In other words, isn't it better to substitute some other means of draft that will give us more than fair average results than to place our dependence on a means the efficiency of which will vary from the maximum to zero with a chance that it will utterly fail at a time when its need is most urgent?

It is a safe statement that no battery commander in the service

will permit his horses even to go to a drill of but a few hours' duration, unless, either by personal inspection or that of one of his lieutenants, he has assured himself that each horse is wearing a collar that has been fitted as accurately as it is possible for experienced men to do. But a point often lost sight of is this, that the great bulk of our field artillery will be composed of militia batteries. Not only will the enlisted men, noncommissioned and privates, of these batteries be inexperienced, but the officers will be found equally so. There will not be many regular officers present to instruct or assist these organizations, and those that are present will have all they can do attending to matters of discipline, subsistence, equipment and organization, with very little time left for the fitting and adjustment of collars. To teach others to do so properly at such a time will not be practicable, because it must be learned by experience, and our press will not allow us much time to gain experience in a mobilization camp, but will be crying for us to "hurl" the enemy back with the slightest delay, regardless.

It is, therefore, imperative that we, above all other nations, should endeavor to supply ourselves with equipment that is as near foolproof as human ingenuity can render it. We can count on losing great numbers of horses, if the meager reports from abroad can be relied on at all, so that it is our duty to do all that we can to keep this loss down as low as possible, at least to the point of not causing losses ourselves by intentionally clinging to equipment through sentiment or what not that we cannot but see will break down when put to the severe test of war conditions.

Everyone in the army must know that our batteries are not going to be horsed with the highest type of draft animal. Boards of officers will not be able to pick and choose and discard at will. No one knows where our horses are coming from. We have no reserve of horses in sight as they had in the continental countries. The horses that we get will be dumped down and we shall be required to make the best of the lot, and some of them will be funny-looking draft animals. Some will not have the least semblance of a shoulder, just a flat surface from head to flank, such as will defy the ingenuity of an expert to fit a collar to. We could not afford to purchase high-class animals, even if available, because the life of a horse in the theater of war averages less than twenty days.

There are substitutes for the steel collar, which, for use in time of war, are more suitable. These are the breast strap or Dutch

collar and the humane collar, both of which have been under test at Fort Myer. The latter would seem to be the better adapted to our needs. Both have been found to be practicable. The humane collar has an advantage over the breast strap, in that it places the point of draft above the point of the shoulder, while the other bears on the point of the shoulder continually. There is a chance, though slight, that horses may choke down with the breast strap; with the humane collar such a chance is non-existent. Both are easily adjusted, simply by taking up or letting out a hole or two in a strap. They are as sanitary as the steel collar, permit of a free circulation of air and when broken can be repaired in the battery without having to be sent back to the manufacturer. They are as near fool-proof as can be and will give a higher average of efficiency in draft than the steel collar.

LETTER TO THE EDITOR.

The following letter vividly attracts attention to a very serious shortcoming which the Field Artillery shares with the other branches of the army—a lack of balance and a lack of sustained effort in carrying out a comprehensive system of training. By its fearlessness and frankness it should command the admiration even of those who do not agree with all the statements it contains.

THE EDITOR,

FIELD ARTILLEY JOURNAL.

Dear Sir:

Before the beginning of the approaching outdoor season I wish to lay before the Field Artillery certain thoughts which I have cherished for the past two years, relating to what I consider an unbalanced method, and lack of coordinated effort in the system of instruction of the Field Artillery. These views are respectfully submitted, merely as an opinion gleaned through close association with various batteries, and as an instructor in one of the classes at the School of Fire, Fort Sill, Oklahoma, and at the Camp of Instruction, Tobyhanna, Pennsylvania.

In considering the status of our Field Artillery at the present time, I am reminded of the story of the case of the "Robert E. Lee." Out on the Mississippi River there is a steamboat plying between Memphis and Natchez, known as the "Robert E. Lee." She has a whistle so large and a boiler so small that whenever they want to blow the whistle it is necessary to shut off the steam from the engine.

With us in the Field Artillery the time was when we all were required to become experts in signalling with the Myer Code. This, if you remember, was paramount, and for that time everything else was left to wiggle along as best it could. Following the signal craze, we were required to concentrate all of our energy upon the subject of topography. Then came first aid, but it was soon forgotten for the Russian ride and the flat saddle, and now as the wheel of time revolves, we find ourselves clutched in the throes of so-called speed and accuracy of fire. No one pretends to signal, there isn't the name of a good first-aid officer on the list, topography is nearly relegated to the dump heap and the Russian ride, like the

"bunny hug" and the "Boston dip," having lived its day, has been obliterated from a conspicuous place in our characteristic one-ideaed rush for concentration on something new.

That is to say, the big whistle is blowing, the steam is cut off from the engine, and the "Robert E. Lee" is serenely drifting down the stream.

By way of illustration of our one-idea methods, it is a fact that recently while commanding a battery in the Philippine Department (and, you know over there they have a detailed progressive scheme of instruction each year), I took my battery out one day in advance of the "scheme" merely to "shake 'um up a bit" on a short road march. Suddenly out of an angry-looking cloud of dust in the rear there loomed up a—well, a "feller that had some influence, to say the very least," and he lit into me with all fours.

"What," said he, "in the name of all the blessed saints are you doing out here with your battery? This is the period for standing gun drill. Your battery is not yet supposed to know how to march."

Now, I had served with that battery myself for seven years, and before my time it had won honors marching and fighting. Yet because one in authority had misinterpreted a "progressive scheme," this efficient battery could not even march at that time of the year. Imagine the folly of any method that even through misinterpretation permits holding a battery down to first one detail of instruction and then another. Under such a method, it seems, we could go to war only at the end of the outdoor instruction season, for only at that time has the "scheme" been completed. As a matter of fact, every battery in the army should be ready at all times to take the field, and every officer should believe this and live accordingly. Not to do so is simply a case of the big whistle and a shortage of steam to blow it.

Of all the cycles which do and have gripped us in the last fifteen years, the most important is, in my judgment, "speed and accuracy." But why go mad over it? Why should we admit that we are like the "Robert E. Lee"? Let us try to install a plant that is in proportion.

Tactics is just as important as speed; draft holds a place with tactics; personnel, administration, battery manipulation in the field, sanitation, all must be considered with the many other details which go to make for field artillery efficiency. These should all be done

together, and in the field. That is, these various necessary elements should and must be coordinated. To concentrate the energy of a battery upon any one of these subjects to the exclusion of the others is no less than absurd. A certain part of each day may properly be devoted to instruction in any one of the subjects, provided that it is understood in the end all are to be coordinated, and the battery is to act as an intelligent, living, efficient unit.

No firing problem should be permitted until the organization has gone through a tactical situation, including all or as many as may be possible of the situations which may properly be expected in time of war. It is no reply to say that if you attempted a compliance with that idea you would never get through with target practice; because if you have to disregard the very important tactical work in order to get rid of the ammunition allowed for target practice, there are but two answers: Either you have too much ammunition, or else the time you are allowed for field work is too short. I prefer the latter, because there is no such thing as too much ammunition when it is properly handled. To place a battery into a position, and then call one officer after another, regardless of whether or not he belongs to that battery, to a firing point so distant from his command that he has no personal supervision, and then let him "blaze away" at some indicated target, is absolute folly. It is making a cheap shooting gallery out of a 3-inch battery. We must learn to shoot, of course, but the range is no place to pick up fundamental details and first principles; that should be done on the blackboard, or on the "smoke-bomb range." I earnestly believe that no officer, regular or militia, should be allowed to shoot anyway, unless some proper authority can certify that he believes the officer competent of solving the average problem.

Further, if we allow from three to five minutes to an officer to get in his first salvo, after a target of advancing infantry has been designated for him, and then let him shoot deliberately at the rate of, say, one salvo in two minutes, we are plainly teaching and authorizing a method of fire which cannot be used in time of war. Not only so, but we are teaching a method that will surely bring disaster to our own troops through exposing a position. In such a case as this, the officer should be stopped. The fact should be pointed out to him, that opposing infantry does not linger around in exposed positions for our convenience, and the officer should be told that he is not ready to perform the duties of a field artillery

commander. The time of getting on a target, almost disregarded in our service, except at the School of Fire, is really the most important of all.

Hohenlohe said that the principles of field artillery are finally summed up in the thrice-repeated word, "Hit," but surely he intended that the time factor be considered. In my judgment, unless a battery can get off at least three salvos per minute during fire for effect, and more than one while adjusting, that battery might far better be out of the theater of operations. I am sometimes inclined to believe that when firing ammunition on the range, speed comes before accuracy in order of importance; that is, unless an officer can get on his target and stay on it with speed, as well as accuracy, he should not be allowed to shoot at all. Send him back to the smoke bombs. If we do allow him to shoot any other way, we are wasting ammunition, accomplishing nothing, and, worst of all, authorizing a method of fire admittedly wrong and contrary to the first principles of field artillery in modern warfare.

The trained, alert resourceful officer who finds the most targets, gets his battery into position to fire at them quickest and best, and then hands out about four salvos per minute, is the one who will be needed in our next war, which is sure to come, and the only one who will be worth his salt in the field. There is only one way of obtaining such a personnel, and that is by training them in time of peace to do exactly what they will be required to do in time of war—and no other way. This, you see, contemplates thorough training in all things, not in the firing battery alone. Another case of the big whistle.

Permit me here to say, I am decidedly not a theorist, just a "plain sodger man,"—a "rough neck," so to speak. I have served the guns in "Cuba and distant Luzon," as the song goes. The word "ballistics" has such a terror for me, that rather than to delve into its intricacies, I would prefer to ride a limber chest for eight miles at a trot over the smooth (?) Calsadas in Tobyhanna, Pennsylvania. But "I know the boys in the ranks" and with a full appreciation of the able argument recently published in your paper referring to the "dropback," all I can say is, "Yes, it is right, but doggone me, I won't do it." Subordinate as I am, I almost feel that if the wires were cut, I would be strongly tempted to drop back a good distance before opening "Fire-for-effect." The purely practical battery commander will be tempted to do it. He also, with a

miser's eye on his ammunition, will shoot his guns, and at least make that noise so encouraging to a waning morale, rather than stand idly by with a pad figuring data, probabilities, and so forth, while good American blood is staining the ground of some unknown future battle field. He will have to shoot—he knows that the only shield worth being behind in time of war is a well-directed and rapid fire. To open and maintain a sudden, well-directed and rapid fire, nine times out of ten, it will be necessary for the battery commander, besides having all other qualifications, to be down with his guns and among his men. In time of war, the men will want to see him fighting and suffering with them—not a mile away, behind a brick house, telephoning orders which are the result of laborious gymnastics with a pad and pencil. There is a human side to war. No one can, or ever has, estimated what the moral effect will be (resulting in efficiency) if the battery commander is down among his men; that is, if he is any good.

We should not be like the volunteer officer in the early days of the Philippine insurrection, who, while marching his company through a trail, heard a distant shot, and promptly turning to his first sergeant said: "Hell, Sergeant, we are attacked; take charge of the company."

The only reason that we now call the officers away from their batteries is to facilitate business for the battalion commander. Absolutely wrong. The battalion commander is there for no other purpose than to facilitate the business of getting the greatest efficiency from his command. His convenience should not be considered. If we cannot get up some means whereby the battalion commander can identify targets to his distant batteries, and then give his orders for them to shoot, we ought to have no battalion commanders. Everybody knows it is a big plant to handle; but if it cannot be handled, it is time now to "bust it up"—not further cripple the guns.

My point is, that while speed and accuracy, that is to say, the firing battery, are of vital importance, we should not because of them overlook tactics, supply, draft, administration and the many other equally important factors. We should have more battalion work, and then more, until some battalion becomes able to pull off a problem that works. Personally, I have never seen but three battalion problems attempted. While none of them were by any means satisfactorily solved, the nearest one to a solution I have seen was

spoiled because two of the battery commanders said in the critique following the problem—by way of explanation of their bad firing—that they were so confused by the firing of the other batteries their work was interfered with. Now, what superhuman power, I petition, is going to take care of these battery commanders in war time, when not only their supporting batteries are shooting, but when their opposing batteries are ranging upon them? We have got to simulate war. It is not enough to say and permit ourselves to believe we are doing it.

Let that splendid institution, the School of Fire, devote all of its time to speed and accuracy. The period of instruction is too short as it is. But let us have the Field Artillery in the line of the army, devote its time not to speed and accuracy alone, but to coordinate balanced effort along such lines as will give us batteries trained in all the essential requirements tending to make for efficiency.

Let us have a School of Application for Field Artillery.

Very sincerely,

ROBERT DAVIS,
Captain, Field Artillery, U. S. A.

CURRENT FIELD ARTILLERY NOTES

Specifications for French Artillery Remounts.

Referring to the illustration of the French Field Artillery Remount on page 500 of the FIELD ARTILLERY JOURNAL *for October-December, 1914, the following specifications governing the purchases referred to have been obtained:*

Example: For active service—height (without shoes):—
Class A—15.2 hands to 16 hands.
Class B—15.1 hands to 16 hands.
Age—5 years to 9 years.

Riding cobs, geldings and mares (not in foal) in fair flesh and condition, able to carry 15 stone (*i. e.*, 210 pounds) under active service conditions.

Sound in action, wind, eyes, practically sound otherwise.
Strong, active and sufficiently fast.
Fair riding shoulders, strong quarters and loins.
Good constitution.
Short, well-shaped back and legs.
Roomy, well ribbed.
Good, clean, straight action.
Strong, clean legs and feet, properly shaped and placed.
Quiet, without vice, well broken and mouthed.
Teeth complete, well shaped, not tampered with.
Color, not very light gray or white.
The remount officer is the sole judge as to suitability.

Grounds for Rejecting Any Horse, no Matter What His Other Conformation may be:

(a) Small, weak quarters.
(b) Flat sides (having due regard, however, to the country in which they are bought).
(c) Long, weak, bending pasterns.
(d) Split up and leggy, or both.
(e) Small joints.
(f) Close hocks or action.
(g) Legs not being well placed.

(h) Any mark of brushing which is not clearly due to bad shoeing.

(i) Any indication of weak constitution.

(j) Very straight pasterns.

(k) Small or uneven feet.

(l) Vice of any kind.

(m) Evidence of fistulous withers.

(n) Evidence of any operation in the teeth.

(o) Bad condition.

(p) Parrot mouth or undershot.

(q) Capped elbows.

(r) Marks of whip or spur, not done under the eye of the inspector, or undue sweating, being properly indicative of vice or bad manners.

(s) Very short docks.

German Anti-Aircraft Bombs.

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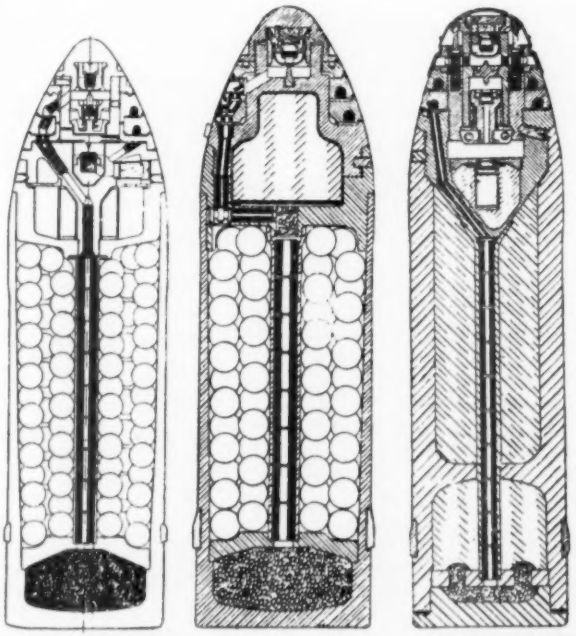
The Ehrhardt anti-aircraft shrapnel, manufactured by the Rheinischen Metallwaren und Maschinenfabrik, Düsseldorf, only differs from the usual design of projectiles of this type, in that the fuse, the moment it ignites the powder in the axial vent communicating with the base-chamber charge, also ignites a delay fuse which leads direct to the grenade charge.

First, the gases of the base charge drive the bullet filling and with it the grenade portion forwards. Then the latter detonates as soon as the delay fuse acts on the grenade charge. If the grenade portion strikes the aircraft beforehand, it will explode on contact. While the bullets fly forward in a closed cone of from 12 degrees to 14 degrees the grenade portion hurls its fragments forward with enormous violence under a cone angle of 200 degrees and for a distance of about 200 to 300 meters in all directions—forwards, upwards, downwards, and sideways. With this shell one, therefore, commands a space of about 700 meters length and about 300 meters width. An aircraft will thus not easily be able to escape if the range has been only approximately found. This shall possesses, apart from its great effect, the advantage of easy observation, as both the shrapnel and grenade portions develop clearly visible clouds of smoke. A smoke trail is, therefore, not necessary, and the space thus saved may be used for increasing the charge of the shell.

The smoke shrapnel on exploding ejects the bullets and simultaneously breaks off the head, which is not, however, filled with an explosive, but with an incendiary charge, which, from the moment of explosion, leaves a trail of smoke that renders its path visible, and, should it hit the mark, ignites the gas of the airship, whilst the object of the bullets is to put the crew *hors de combat*.

The balloon grenade is filled with an explosive charge, behind which is a base-chamber filled with an incendiary charge. This is ignited by means of a fuse in such a manner that it begins to develop a trail of smoke 250 meters before the projectile reaches its intended point of explosion, and continues to do so until a distance of 250

meters behind the point of explosion. If, in the meanwhile, the percussion fuse has not exploded the grenade, the time fuse will have reached the charge through another passage and brings the grenade to detonation. If this takes place near the aircraft, the fragments will damage this more or less.



All three types have the advantage that they come to pieces in the air. There is thus little danger of causing damage to friendly troops, since the pieces are of small size and fall relatively slowly.

Veterinary Notes on Naco Movement.

Veterinarian Charles H. Jewell, 5th Field Artillery, has submitted some interesting veterinary notes bearing upon the recent movement of three batteries of the 5th Field Artillery from Fort Sill, Oklahoma, to Naco, Arizona. This is the first movement of heavy field artillery by rail in our service.

The shipment was made in three sections, each section consisting of the horses and matériel of one complete battery. Regular stock cars, 36 feet long, were used; and the horses were loaded as closely as possible, 19 or 20 horses being placed in each car. The cars were bedded down with sand. Horses were not tied, but the halter headstalls were left on and the tie ropes either removed or tied up out of the way. Although the weather was cold, horse covers were not used en route, except by one battery, which ran into a storm while crossing the mountains of New Mexico. In this case the use of horse covers was not satisfactory: the horses rubbed them off, got them under foot and thus caused some confusion.

The trip of about 1,000 miles was made in the comparatively slow time of 72 hours. During this time the horses were unloaded twice for watering and feeding. At each unloading the horses were first watered, and then fed a full allowance of hay and one-half to two-thirds allowance of oats. Before being reloaded, they were given an opportunity to exercise in the yards. During the time the cars were empty, they were carefully examined and all necessary repairs were made and the floors were again bedded down with sand or cinders. The cinders were preferred to the sand, as they made a drier bed and kept the floors in better condition.

The use of common stock cars, even in severe winter weather, resulted in no suffering from exposure because of the heat generated by the closely packed animals. Common stock cars are more quickly loaded than any other type. In this movement, the average time to load the horses of a battery was 30 minutes. Unloading was accomplished more quickly.

Weather conditions found at Naco upon arrival were as bad as could be imagined. It rained in torrents for three days; and at night the thermometer registered close to zero. There was no shelter for the animals; but all the batteries were supplied with blanket lined horse covers.

The only sickness which developed consisted of one or two slight cases of colic and a few cases of scratches. As these horses had been accustomed for years to warm stables, their comparative freedom from sickness under the very unfavorable conditions at Naco can be attributed only to the high altitude and the use of the blanket

lined horse covers. In order to prevent skin diseases such as scratches, mud fever and grease, no attempt was made to clean the legs, although the animals were compelled to stand in mud half-way to their knees for nearly a week.

In view of the fact that the unit equipment for field artillery omits the horse cover, which is supposed to be used only in exceptional cases when so directed, the absolute dependence of this command upon the horse cover even in such a southern latitude as Naco is worthy of the serious attention of the War Department.

During this tour of duty at Naco one-half the allowance of hay consisted of alfalfa, the other half being prairie hay of poor quality. The horses ate the alfalfa greedily, gained steadily in flesh and suffered no ill effects. In Dr. Jewell's opinion, the prejudice against alfalfa as a ration for army horses is not well founded, and the ration should be modified so as to provide alfalfa for one-half of the allowance of hay whenever it can be obtained.

The horses were at first shod on all four feet, but so much trouble was experienced from severe kicks received while on the picket lines that the hind shoes were removed. As there were no hard roads or cobblestones in the vicinity no ill-effects of removing the shoes developed. The advisability of removing the hind shoes when horses are kept on a picket line should always be considered.

Field Letters of a German Field Artillery Officer.

These letters written to the editor of "Artilleristische Monatshefte" are brief, to the point, professional—just the intimate details of his profession which the officer of Field Artillery is anxious to obtain and which are so often omitted in newspaper accounts of the war. For the translation we are indebted to 1st Lieutenant Edmund L. Gruber, 5th Field Artillery.

"My first battle, with my battalion is behind me. At ——— my battalion surprised with its fire the 6th French Cavalry Division, including cyclists, chasseurs and machine guns; our fire at 3,400 meters drove the whole outfit into a mad flight; the road to ——— was strewn with carriages, wagons, men and horses. Three (?) French horse batteries, completely masked and out of sight, opened with a heavy fire upon us. We never found them at all. Their adjustment was quick and very good—four salvos; shots fell in front of and behind us; but hardly hit anything. Our shields are

splendid; the hostile fire just made a rattling noise on them even though my battalion was in the open and not behind any cover. The men behaved splendidly, just as at Gravelotte. And now comes the finish:—hostile fire from the flank and rear coming from the heavy guns of Fort ———, 7,000 meters. But this also was ineffective; nevertheless, I was worried and in fear lest the battalion be annihiliated. The shots were too high; some failed to burst. We suffered a slight loss in dead and wounded. Nevertheless, we had no time for fear; it was a case of fight. The French infantry also shot poorly; up to the present time they run as if they were hunted. The methods of warfare are frightful; the inhabitants participated as in the wars of 1870. *Vae Victes.*

The Bavarians fight like lions; we are full of confidence. The heat is frightful, sometimes there is scarcity of water. But we must win. Parole: No fear."

—*Artilleristische Monatshefte,* August, 1914.

AUGUST 30, 1914.

"After my seventh fight I find myself compelled to revise my opinion of the French Field Artillery. Up to date, it is the only branch that is doing anything at all in our theater of operations. In our first engagements we were opposed by horse batteries only; but now in the big battles along the Meurthe and the Vezouse we are meeting the enemy's main force—light batteries and above all, heavy batteries in fortified positions. They are very cleverly emplaced, hard to find and direct a terrific fire at us. It is remarkable how quickly they find us, in spite of the masked positions which we almost always take. They must have very accurate range finders. They usually get a correct bracket with two to four salvos and right after that follow "rafales" with five or ten minute pauses. But the effect is then only like a hail storm. They shoot at greater ranges than we do—with light batteries mostly around 5,000 meters, very often also 6,000 meters and more. From information obtained from captured officers, their aeroplanes are giving them valuable service in reconnaissance. Also, in this hilly terrain they have registered and know every position. The inhabitants help to disclose our positions. A well-organized service of observation and reconnaissance is giving them great help. We have found their telephones in hollow

trees, woods and church towers. Men who have been left behind operate them. On the —— at —— their fire was directed by persons in rear of our position; therefore, this rapidity in adjustment. We almost stare our eyes out and cannot find them. The effect of the light gun projectiles is very small, unless a direct hit by chance is made on a gun. Their shrapnel does us very little harm; the effect of the percussion shell is very local—only a few meters. The Infantry in attacking over open ground suffer enormous losses. They are too impetuous. At ——— the Bavarians suffered heavy losses from artillery fire. The French Infantry holds back too much. very seldom gets into the fight properly and turns back as soon as we fire upon them. Their Infantry simply has not the "go ahead" that characterizes our Infantry. The heavy artillery also shoots well and at —— produced great effect against the —— artillery, which again took a position in the open. Telephone, aiming circle and scissors observing telescope are indispensable. Except when necessary in a pursuit, it is foolish to take a position in the open. At Lagarde our light howitzers did splendid work: a French battery was completely knocked out by time shells in a very short time. The French have a holy fear for our heavy howitzers. If these once get their target they finish it in a short time. At ——— my battalion attacked a rear guard battery from the flank with about a hundred shots and knocked it out so that all the ammunition wagons were left behind; a little later then at —— three guns of this battery were found in a field. Here in Lorraine, one sees standing everywhere on the battlefields large groups or trains of abandoned ammunition wagons filled with ammunition; these are immediately blown up. I husband my ammunition very carefully, but in spite of this I am compelled to open fire at 5,000 to 6,000 meters if I want to get in any firing at all. Nevertheless the effect is said to be very good, especially with percussion shell. Against large columns in retreat one can afford to expend ammunition at these ranges, the moral effect alone is great. At ——— on the 18th, we fired at a range of 2,400 meters at heavy columns and skirmish lines and produced a remarkable effect; one could practically see the yawning gaps produced by the shots. The incendiary effect of shell in villages is very good. We always shoot up the church towns first, because they are almost always occupied with machine guns. In

doing so we have sometimes burnt down our own German villages. The effect of the 42-centimeter mortars at Manonvillers was simply terrible. After 36 hours the fort was demolished, not a gun was able to continue fire. Four hundred men surrendered, giving as a reason that the air was so full of poisonous gases that they became suffocated. One of my officers went up and said there were holes and craters there in which a whole battalion could easily be hidden. Well, we are going ahead smoothly. Reports of victories follow one another quickly, and as a result there is daily rejoicing among the troops. But on account of the fortifications it is not likely that we will make the same rapid progress as was made in Belgium. May God help us on to Paris!"

—*Artilleristische Monatshefte*, September, 1914.

General Rohne's Contemporaneous Notes.

The name of the distinguished German artillerist makes authoritative these notes which are in themselves timely and of great professional interest. We are again indebted to 1st Lieutenant Edmund L. Gruber, 5th Field Artillery, for the translation.

The Aeroplane for Artillery Reconnaissance.

Both the French and the Germans have used aeroplanes to reconnoiter targets for the artillery, especially to reconnoiter batteries behind masks. The French aeronauts locate and designate the targets which they have found by dropping on such targets smoke bombs or projectiles which on impact produce smoke that on rising remains distinctly visible. This ball of smoke is at once spotted at the observing station, the deflection change is read and sent to the battery, which after a very short time is able to open fire approximately correct for deflection.

We do not know whether air scouts are also used to sense shots for the purpose of obtaining adjustment as is described in French regulations. According to regulations, every regiment is supposed to be provided with an aeroplane for just such purposes. It is very possible that the destruction of the Aeropark at Reims has put a crimp into the arrangement. But it may also be possible that their aeroplanes which under ordinary circumstances are near to the batteries, were not noticed by our German batteries which at the time had other important things to attract their attention.

Pictures of Captured French Guns.

The pictures shown in Plates I and II of captured French guns not only confirm what we already knew of the matériel but also give a good representation of the effect of our projectiles.

Plate I shows a 75-millimeter gun and carriage, standing on the firing brake shoes. One of the lower shields is down, the other is hooked up. The shield shows three perforations made by our S bullets.

As seen from the position of the gunner, the gun appears trav-

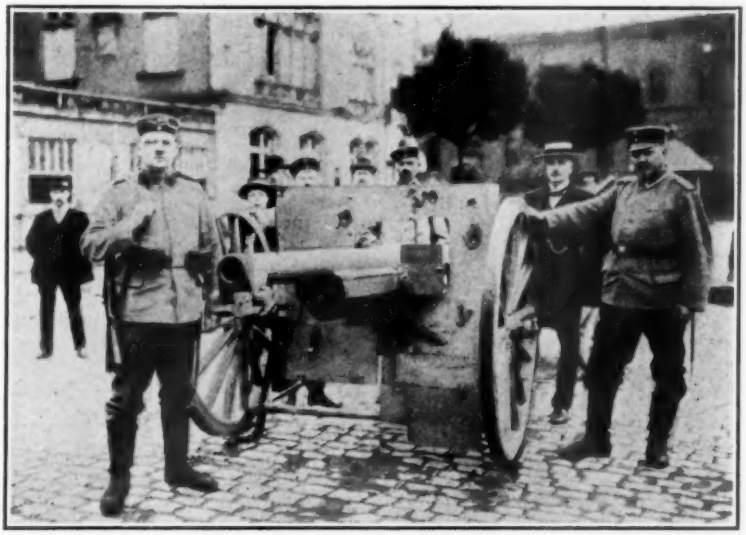


PLATE I.

ersed to the left for this reason a wide interval is visible between the edge of the shield and the right wheel. The height of the shield is 1.40 meters, that of the wheels is 1.35 meters.

Plate II shows the rear of a 75-millimeter gun tube, in which the breech and breech block have been blown off by one of their own projectiles. To one side, the range drum is seen with the range scale up to 5,500 meters.

Plate III shows in the foreground an unlimbered ammunition wagon. The wheel on the near side shows four spokes and a part

of the felloes completely shattered by a fragment. The near wall of the wagon body is perforated by numerous fragments.

Range Table of the 75-Millimeter Gun, Model 97.

An original range table of the French 75-millimeter gun has come into my possession, which helps to fill many little gaps in our knowledge of this gun.

The tables first give data concerning certain weights and measures.

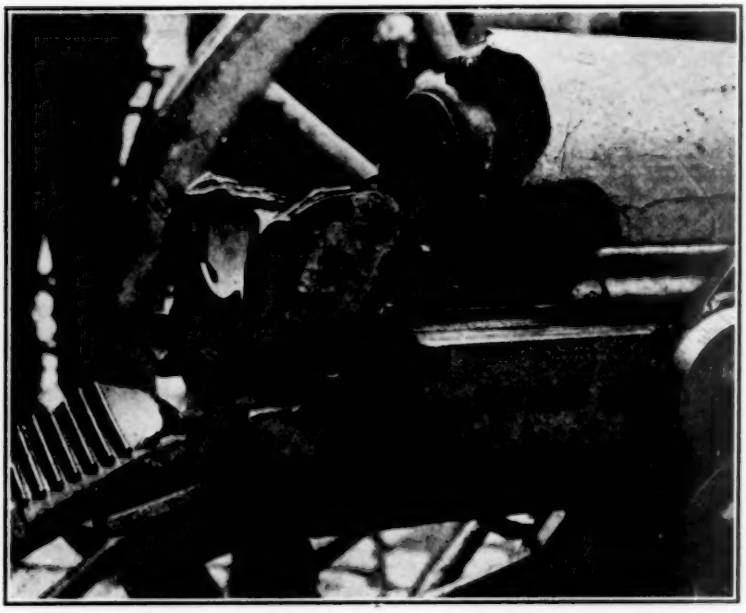


PLATE II.

The tube has a length of 2.721 meters, therefore a little over 26 calibers and weighs 461 kilograms. The original shrapnel used had a base bursting charge just as I have stated in my book on the "French Field Artillery." The *obus Robin*—officially known as m/1907 m, was not adopted until later. The latter contains 290 bullets and weighs 7.24 kilograms. The smoke producing matrix and bursting charge weigh 440 kilograms. The percussion shell weighs only 5.315 kilograms; its propelling powder charge weighs

only 665 grams, while the propelling powder charge for the shrapnel is 700 grams. But in spite of this, the initial velocity of the shell is 584 meter-seconds, as compared to 529 meter-seconds for the shrapnel. The bursting charge of the shell is a mixture of cresylite and melinite and weighs 825 kilograms. The maximum percussion range of the gun is 8,500 meters; the maximum time shrapnel range is 6,800 meters, although the fuse cutter is so graduated as to permit a setting up to 6,300 meters only. Since the range drum is graduated up to 5,500 meters only, it evidently becomes necessary to use a

PLATE III.

quadrant for ranges over this. But, strange to say, their regulations prescribe nothing concerning this.

The carriage being on the level ground, the greatest elevation of the gun is +18 degrees, which corresponds to a range of 6,800 meters.

The following is an extract from their range table, in which the probable error has been doubled in order to give the 50 per cent. zone, commonly used in our tables, thus facilitating comparison:

TABLE I.

Range.	Elevation.	Angle of Fall.	Time of Flight.	Terminal velocity.	50 per cent. Zone Percussion fire.			50 per cent. Zone for bursts.		One-half the Angle of Opening.
m	° ′	° ′	sec	m	h	w	l	h	l	° ′
500	26	36	1.0	473	0.2	0.2	13.	0.4	33.6	6 57
1,000	1 6	1 25	2.2	422	0.4	0.6	14.4	1.0	35.8	7 38
1,500	1 51	2 25	3.4	379	0.6	0.8	15.8	1.8	38.4	8 20
2,000	2 43	3 39	4.8	346	1.2	1.2	17.6	2.8	41.2	8 57
2,500	3 41	5 4	6.3	320	1.8	1.6	19.4	4.2	44.0	9 31
3,000	4 46	6 43	7.9	300	2.6	2.2	21.6	7.0	47.0	10
3,500	5 57	8 34	9.6	283	3.6	2.6	24.0	8.4	50.2	10 27
4,000	7 16	10 39	11.4	269	5.0	3.2	26.6	10.0	53.2	10 51
4,500	8 43	12 58	13.3	257	6.8	3.8	29.6	11.6	56.4	11 13
5,000	10 19	15 31	15.3	246	9.2	4.4	32.8	13.2	59.6	11 35
5,500	12 5	18 20	17.5	237	12.0	5.2	36.4	15.0	62.8	11 53
6,000	14 3	21 28	19.9	230	16.0	6.0	40.4	16.8	66.0	12 9
6,500	16 17	24 55	22.4	224	21.0	7.0	43.2	18.8	69.2	12 22
7,000	18 50	28 48	25.2	219	27.8	8.0	50.8	.....	.....	.....
7,500	21 54	33 16	28.5	215	37.8	9.4	57.6	.....	.....	.....
8,000	25 53	38 43	32.4	213	53.8	10.8	67.0	.....	.....	.....
8,500	32 41	47 10	38.6	215	91.4	13.4	84.8	.....	.....	.....

Tables II and III then tell how the proper height of burst is regulated from the very beginning when firing at great altitudes.

The Range Table I is calculated for an altitude above sea level of 150 meters when firing in altitudes greater than this, the normal corrector setting will give grazes or bursts that are too low; therefore to obtain higher bursts the time train of the fuse must be shortened.

Table II is based upon a fuse with graduations in seconds. This no doubt has been discarded and is therefore of no interest to us.

Table III shows by what amount the corrector must be changed when firing at great altitudes to obtain the proper height of burst. For example, at an altitude of 500 meters above sea level, the corrector should be raised 2 at 3,000 meters range; at altitude 1,000 meters above sea level, the corrector should be raised 10 at a range of 5,000 meters. *Tables II and III not reprinted.*

If the necessary change in the corrector exceeds 5, the number of mils in even multiples of 5 is added to the angle of site and only the remainder is set off on the corrector scale of the fuse cutter. Example: At an altitude of 2,500 meters above sea level, the corrector for a range of 3,500 meters must be raised 17. Instead of doing this, 15 mils are added to the angle of site and the corrector is raised by only 2.

The use of the table is unnecessary if the following rule is remembered. The product of twice the range by the altitude above sea level—both expressed in thousands of meters—will give the amount by which the corrector should be raised. Using the last example, we have 2 x 3.5 x 25=17, whereas, the table gives 16.8. For the German gun this rule would read: The product of the range by the altitude above sea level—expressed in thousands of meters—would give the number of divisions by which the angle of site is to be increased. In the light gun this corresponds to the change to be made on the regulator—but this is not true for the light howitzer, where one division of the regulator is 3/16 of a degree, or approximately 3 1/3 mils.

A fourth table gives the amount by which the range drum is to be changed when passing from shrapnel to shell fire. Up to 3,000 meters the same range can be used for both projectiles. At ranges greater than this, the range, when passing to shell fire, is to be increased by an amount equal to 1/10 of the excess over 3,000 meters, rounded off to the nearest multiple of 25. For example: If the last shrapnel range used is 4,000, then in passing to shell fire, the range scale is set for 4,100.

French Aero Arrows.

French aeronauts have made use of a new style of projectile against our troops. The projectile is a long, cylindrical, steel arrow, about 12 centimeters in length, 8 millimeters in diameter, weighing 20 grams, with a sharp point 1.5 centimeters in length. Longitudinal grooves, 8 centimeters in length, are cut in at the other end, the purpose of which is to prevent the arrow from tumbling in its flight. The wounds which they produce are usually very insignificant. So far only one arrow, which struck a man in the temple, has produced a mortal wound.

The following tribute to the memory of two distinguished artillery officers, one a comrade and the other an honored and respected enemy, is an example of the deference with which soldiers have always regarded courage and ability whether in friend or foe. It is in startling contrast to the bitter hatred which is so characteristic of the writings of the non-combatant.

Lieutenant General Steimmetz.

The Inspector General of the 3d Foot Artillery Inspection, Lieutenant General Steimmetz, was killed on September 15 in a fight at

Guignicourt, where he commanded a division. This is the first time that an officer of the Foot Artillery has led in battle a force composed of all arms. The deceased, in the many important posts which he held, rendered exceptional and distinguished service for his branch of the service.

The son of a Protestant preacher, he was born on April 15, 1860, at Grünberg in the Grand Duchy of Hessen; in 1879 he left the cadet corps and was commissioned in the 3d Foot Artillery Regiment. After attending the *Kriegs Akademie* (War College) he was detailed on the Great General Staff from April 1, 1890, to March 31, 1891, on which duty he found opportunity to carry out more intensively his military studies.

After serving for three years as instructor at the Artillery and Engineers' School, and again serving a short tour of duty with troops, he was detailed on duty in the Ministry of War. From 1907 to 1911 he was Commandant of the School of Fire for Foot Artillery, and in this capacity exercised a great influence in shaping and preparing the Drill Regulations and also the Firing Regulations for Foot Artillery (1908). In 1911 he took command of the 2d Brigade of Foot Artillery, and in November he became Inspector General of the 3d Foot Artillery Inspection, in which capacity he was promoted to Lieutenant General and recently took part in the sieges of Liége, Namur and Maubeuge, for which services he was decorated with the Iron Cross, II Class.

The French General Percin.[1]

Through the numerous extracts from his writings which from time to time have appeared in this journal, the name of General Percin, who undoubtedly stands out today as the most distinguished artilleryman of modern times, is well known to the readers of the *Artilleristische Monatshefte*. If, as is reported, the French Artillery, which is far superior to any other branch of their army, has placed many difficulties in our way during this war, the credit for this is certainly due to General Percin. During the five years that he as inspector directed the firing and training of the Artillery, he was tireless in his efforts to impress upon his officers those fundamental principles on the use of Field Artillery which he had recognized as correct.

[1]EDITOR'S NOTE: *The death of General Percin has not been corroborated.*

According to French newspaper reports, there is no longer reason to doubt that he is dead. The first report was that he had been shot by mutinous troops who placed upon him the blame for the delay of an army of 200,000 under his command, in its march into Belgium. He, on the other hand, is said to have placed the blame on the deficiencies in equipment and supplies. A later report states that he was shot as the result of a sentence by a court-martial, the charge being that he held up for four days an order sent to him for transmission and delivery to the English Allied Army.

Which of these two reports is correct is uncertain. Suffice it to say, that General Percin was not in great favor with the French administration, because he opposed the alliance with Russia. In addition, twelve years ago, in his capacity as bureau-chief to the Minister of War, General André, he incurred the hate of that part of the officers' corps professing clerical and Bonapartistic sympathies. His death has a symptomatic significance, for as in the war of 1870-71, an attempt is again being made to find a traitor and a scape goat.

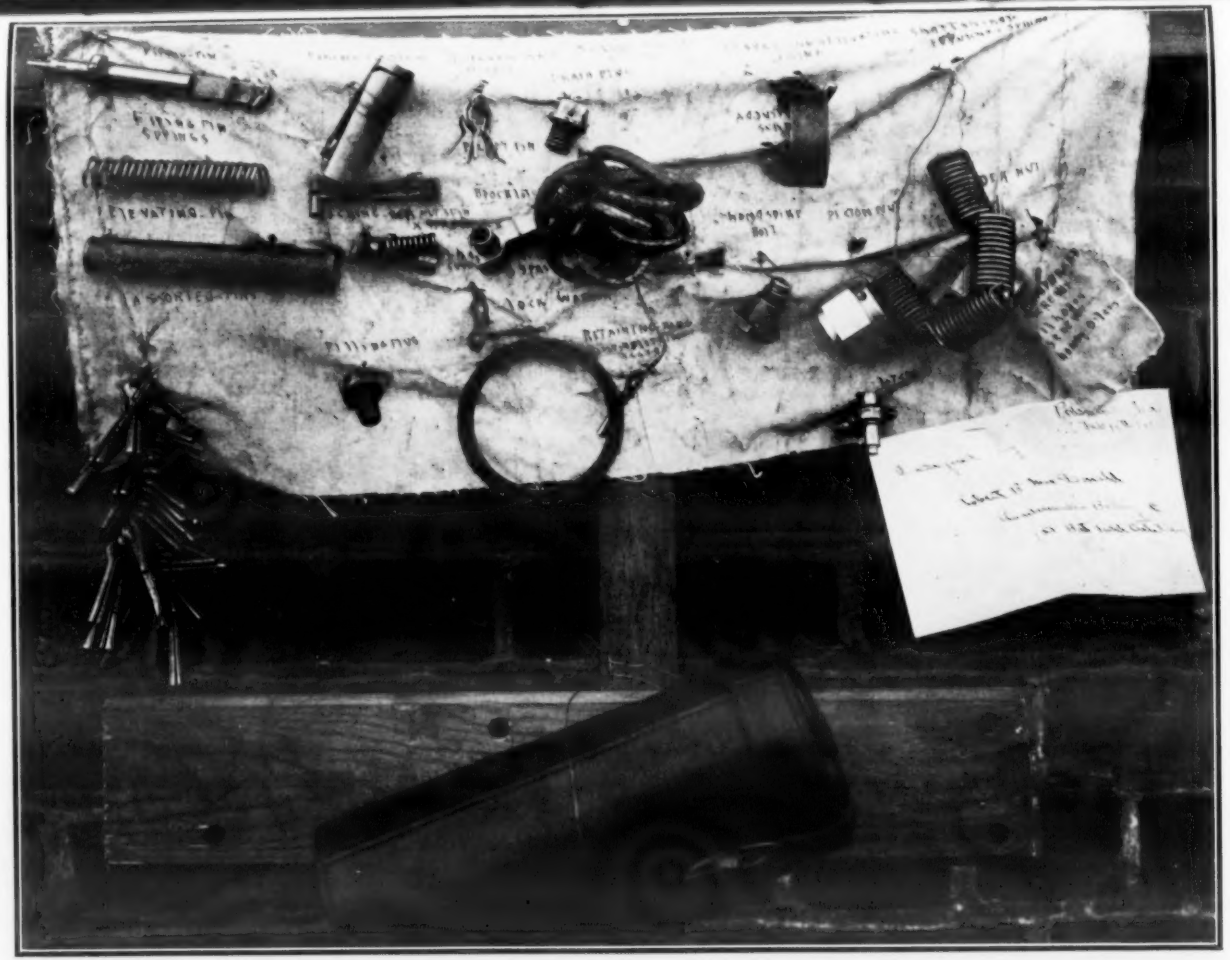
Whatever our opinions may be of General Percin as a politician, his name will survive as one of the greatest pioneers in the development of modern field artillery.

—*Artilleristische Monatshefte*, October, 1914.

Arrangement of Spare Parts, Saddler's Materials, Etc.

Many methods of identifying and arranging the spare parts and the various articles comprising the saddler's materials of field batteries have been devised; but many of them are more suitable for the store room or armory than for the field. Second Lieutenant Robert B. MacDonald, Battery C, Organized Militia of Virginia, has put into practice a system in which each article is fastened securely to a piece of strong cloth which may be rolled up and placed in the proper compartment or carriage whenever the battery is packed for the field. The articles are arranged in the exact order in which they appear in the handbook of the 3-inch matériel, the correct nomenclature is used, and the required number required to equip the battery fully is noted after the name. For convenience and for ease in making inventories, it would be hard to improve upon this system. For current use it is assumed that a sufficient supply of each article will be issued and dropped as expended.

Some of the saddler's materials are shown in the following illustration; and the articles carried in the spare part pouch in the trail box of a 3-inch gun are illustrated on the opposite page.



ARRANGEMENT OF SPARE PARTS CARRIED IN POUCH. 3-INCH GUN.

Devised by 2d Lieutenant Robert B. MacDonald, Battery C, Field Artillery, Virginia Militia.

Accidental Explosion of Shell.

An old style, point-fuzed common steel shell recently exploded in one of the caissons of Battery E, 6th Field Artillery, at Laredo, Texas, while the battery was moving at a trot over a macadam road.

The projectile alone exploded, the base of the shell and the propelling charge remaining intact in the cartridge case. The other ammunition in the caisson consisted of fourteen common shrapnel and nineteen common shell. This ammunition was badly twisted

and broken, as may be seen in the illustration above, but did not explode. Practically all the rivets of the caisson chest were blown out, the entire front torn off, and fragments were blown through the top and bottom.

This ammunition had been subjected to an unusual amount of handling and jolting during the past ten months. It has been carried constantly at drill over all kinds of ground and upon two marches of approximately four hundred miles. The waterproof hoods were

4-INCH CAISSON AFTER EXPLOSION OF COMMON STEEL SHELL.
Battery E, 4th Field Artillery, Laredo, Texas.

on all the rounds of shrapnel at the time of the accident. No injury or loss of life resulted.

A general view of the caisson after the accident is shown on the preceding page.

Armored Cars and Motor Tractors.

The subject of providing motor cars for various purposes has been under consideration by the Ordnance Department for many years. As far back as 1906 and 1907, tests were undertaken with a truck purchased by this department, to determine whether sufficient development had been attained in motor vehicles to make them suitable for battery and store wagons. At that time, however, these vehicles were not sufficiently perfected for this purpose.

The subject was, however, being continually studied and in 1912 steps were being taken to procure from France a Panhard motor tractor which was designed, it is understood, on suggestions made by Colonel Deport, and which apparently had given excellent satisfaction in France.

The main feature of this tractor was that it possessed a four-wheel drive and steer. Arrangements were finally made to have one of these tractors shipped to this country for demonstration purposes, as the company refused to sell it outright. Due to the outbreak of the war, however, this tractor was never received.

At the same time, the development of motor trucks in this country was being watched and various manufacturers were asked to cooperate with a view to procuring satisfactory motor vehicles for war purposes. A four-wheel drive and steer truck has recently been purchased from the Jeffrey Company, to which will be fitted armor, and a revolving turret, and in which will be mounted machine guns. Another car of the same type has been purchased for the same purpose.

The Jeffrey truck is also satisfactory as a motor tractor and it is the intention to carry on competitive tests in order to procure a tractor suitable for hauling guns and ammunition vehicles for artillery.

It is understood that motor tractors will soon be sent to the Field Artilery Board at Fort Sill, Oklahoma, for test.

Aeroplanes for Our Field Artillery.

It is understood that two aeroplanes will be sent to Fort Sill for test during the summer in connection with field artillery reconnaissance and fire control.

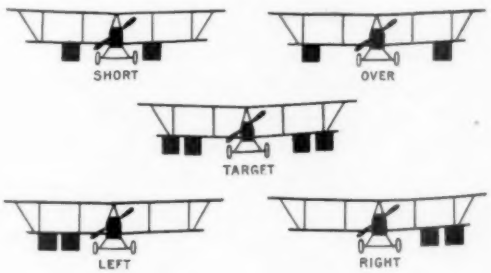
Fire Control From Aeroplanes.

From contemporaneous notes it is learned that field artillery fire control by means of aeroplanes can be divided into three general classes. It is obtained by wireless telegraphy, by the aid of smoke bombs, and by visual signals.

By means of wireless telegraphy one English officer performed the almost incredible feat of putting a battalion of field artillery successfully on nine different targets in about two hours. This was near Ypres.

The German method is also very successful. When the aeroplane is directly over the target, the pilot drops a smoke bomb. The battery commander, who has been following the aeroplane with scissors instrument and self-contained-base range finder, takes a reading at the instant the bomb is dropped. He thus has all the necessary information to open searching fire.

The French dependence upon visual signals has proved comparatively slow and unsuccessful. It is necessary for the aeroplane to return toward the battery far enough to make the signals distinguishable. The signals are as follows:



EDITOR'S NOTE: *It is observed that the method here described as being German is practically the same one as is referred to in General Rohne's notes as being a French method.*

Contemporaneous German Advice on Artillery Training.

The following quotation from the German Minister of War's letter of advice on the training of new German armies, dated September 26, 1914, appears to sum up in few words some of the more modern aspects of field artillery knowledge.

The field artillery and the heavy artillery of an army nowadays fight almost exclusively in entrenched positions. Careful attention should be given to the instruction of the artillery in the tactics of entrenchment. The tactics of the search for the enemy's artillery—which is also nearly always in covered position—are a necessary part of that instruction. Batteries in this war are often employed from isolated positions in order to take as much advantage as possible of the shelter afforded by the natural features of the country. Nevertheless, fire control to keep the fire of the guns (both as regards rate and direction) at the best possible pitch must be maintained over all the artillery units. Otherwise, there would inevitably result an intolerable waste of ammunition.

It is necessary, speaking generally, to attach the highest importance to the economy of ammunition. Each shot fired uselessly is a crime.

THE AIR SERVICE.

The rôle of the aeroplane in war has taken on an unexpected degree of importance. Their working should be carried on in very close connection not only with the general command but also with the artillery command. Every possible effort should be made on the maneuver grounds to train for a close cooperation and a reciprocal understanding between the aeroplane service, the general command, and the artillery.

Aviators on reconnaissance should be provided with pistols and with hand grenades. Though these latter produce no appreciable result for the most part, nevertheless they have an important effect in creating alarm among the enemy, and should therefore be employed.

NOTES REPRINTED FROM SCHOOL OF FIRE NOTES.

DETERMINATION OF THE BRACKET WITH 3-INCH GUN.

1. In ranging with single rounds at zero height of burst at 200 yard bracket may be obtained by bounds either of 400 yards, split, or by bounds of 200 yards. In the first case the correct bracket depends upon correct observations of three rounds, in the last case of two. Of all rounds sensed, regardless of range, 91.4 per cent. are correctly sensed. Thus brackets will be correctly determined, insofar as observation alone is concerned in $(.914)^3=76.4$ per cent. of the first cases, and in $(.914)^2=83.5$ per cent. of the last cases.

2. The bracket at 4000-4200 yards based on single rounds, is correct, due to dispersions in range, in only 82.8 per cent. of the cases.

3. Hence, it is possible *in the long run* to obtain correct 4000-4200 yard brackets by observations of single rounds, considering both dispersions in range and erroneous observations, in .764 x .823=63.5 per cent. of the first cases and in .835 x .828=69.1 per cent. of the last cases. Or, the incorrect brackets to be expected are 36.7 per cent. and 30.9 per cent. respectively.

4. It is possible for dispersion to compensate for an incorrect observation. For example, the center of impact being beyond the target a round may fall short; if it is erroneously observed as beyond the errors are balanced and the result is correct. Consideration of such cases is, however, omitted.

5. General Rhone (Art. Mon., Oct., 1907) calculated that with a 50-meter 50 per cent. zone at 4000 meters 37.45 per cent of all 200 meter brackets based on single rounds should be incorrect due to dispersion in range and to erroneous observations, taking one-ninth of all sensings as incorrect.

6. A bracket of 4000-4200 yards on sensings of two rounds at each range may be determined by the same systems of bounds. Assuming that the erroneous sensing of a single round (as, for example, in the sensing of a bracketing salvo as both short or both beyond), will not affect the determination of the bracket—assuming, in other words, that both rounds at one or all of the ranges must be erroneously sensed to produce an incorrect bracket—it is similarly computed that, due to erroneous observations and to dispersions in range, in bounds of 400 yards, split, the 200 yard

bracket will be wrong in 7.8 per cent. of the cases, by bounds of 200 yards, in 7.1 per cent. Rhone computed about 14 per cent.

7. The chance of obtaining an incorrect bracket of 4000-4200 yards on account both of dispersions in range and of erroneous observations of all the rounds of one or more battery salvos is, by either methods of bounds, less than 1 per cent. Rhone computed 2 per cent.

8. The above data and the results computed for other brackets and ranges are tabulated below, giving the percentage of incorrect brackets to be expected at various ranges and by various bounds, based on observations of one, two and four rounds at each critical range, considering both dispersions in range and erroneous observations. By critical range is meant the range of any round or group of rounds, the correct sensing of which is necessary to the determination of the bracket.

By bounds of yards.	No. of critical ranges	2000-2400 or 3000-3400			4000-4400		
		1*	2	4	1	2	4
400	2	22.3	3.2	0.2	23.2	3.4	0.2
400	3	.....	.....	.....	.....	.....	.....
400	4	.....	.....	.....	.....	.....	.....
200	2	.....	.....	.....	.....	.....	.....
200	3	.....	.....	.....	.....	.....	.....
100	2	.....	.....	.....	.....	.....	.....
By bounds of yards.	No. of critical ranges.	2000-2200 or 3000-3200			4000-4200		
		1	2	4	1	2	4
400	2	.....	.....	.....	.....	.....	.....
400	3	35.1	6.6	0.6	36.7	7.8	0.8
400	4	.....	.....	.....	.....	.....	.....
200	2	29.0	5.9	0.6	30.9	7.1	0.8
200	3	.....	.....	.....	.....	.....	.....
100	2	.....	.....	.....	.....	.....	.....
By bounds of yards.	No. of critical ranges.	2000-2100 or 3000-3100			4000-4100		
		1	2	4	1	2	4
400	2	.....	.....	.....	.....	.....	.....
400	3	.....	.....	.....	.....	.....	.....
400	4	53.0	18.4	4.2	55.7	21.9	6.2
200	2	.....	.....	.....	.....	.....	.....
200	3	48.5	17.8	4.2	51.6	21.3	6.2
100	2	43.7	17.2	4.2	47.1	20.7	6.2

* The figures in this line show the number of bursts considered as observed at each critical range.

9. From the above analysis the following conclusions seem justified:

(a) Ranging with a single piece should not be resorted to.

(b) Brackets based on the observation of a single round at each critical range are very uncertain.

(c) Four hundred and 200-yard brackets based on the observation of two rounds at each critical range are very certain; 100-yard brackets are very uncertain.

(d) All brackets, not narrower than 100 yards, based on the observation of four rounds at each critical range are very certain.

(e) The uncertainty of the bracket decreases with the number of critical ranges—an argument for the range finder.

(f) Good eyesight and training in observation are essential.

S. of F. for F. A., December, 1914.

COMMON ERRORS IN FIRING.

1. Slowness.
2. Lack of concentration.
3. Lack of decision.
4. Firing from wrong flank.
5. Target not correctly and surely identified, usually through failure to use permanent or temporary point in landscape.
6. Forgetting to give range in command.
7. Parts of commands omitted.
8. Commands in wrong sequence.
9. Changing range in wrong sense.
10. Attempting too narrow a bracket.
11. Failing to take range finder range to nearest hundred for first salvo.
12. Changing range finder range on no sensing.
13. Limits of bracket forgotten.
14. Unnecessarily repeating salvos sensed for range.
15. Sensing limit of a bracket on single round.
16. Sensing short limit on high burst, effect short.
17. Incorrect sensings for range.
18. Appropriately narrow bracket not attempted.
19. Too narrow bracket attempted.
20. Sensing of verifying salvo not awaited before firing for effect.
21. Attempting narrow bracket with single piece.
22. Deflection changed in wrong sense.
23. Failure to shift sheaf promptly.
24. Immaterial corrections for direction.
25. Front of target not covered.

26. Sheaf too wide.
27. Part of sheaf off target.
28. Immaterial corrections for distribution.
29. Failure to change angle of site for very high bursts at first salvo.
30. Use of erroneous angle of site.
31. Immaterial corrections for height of burst.
32. Poor sensing of height of burst.
33. Failure to raise corrector or angle of site after below graze bursts.
34. Failure to raise corrector or angle of site on lost below.
35. Failure to change angle of site on unexpectedly high or low bursts at first salvo.
36. Slowness in attempting adjustment of all the elements.
37. Using more guns than called for by importance or size of target.
38 Failing to fire for effect, adjustment completed.
39. Failure to observe during fire for effect.
40. Failure to observe physical effect on target.
41. Failing to eliminate plainly ineffective ranges.
42. Timidity in making corrections.
43. Using field glasses or other observing glass too long before burst may be expected.
44. Failure to use battery detail.
45. Failure to study terrain during lulls in firing.
46. Failure to study maps available.
47. Inability to apply sensings.
48. Failing to assign battery detail to duties.
49. Failing to discover apparent errors in data furnished by instrument sergeant.

S. of F. for F. A., January, 1915.

TARGET POSITIONS AND THEIR PROBABILITIES, WHEN RANGING WITH THE 3-INCH FIELD GUN.

NOTE.—The following tables present the probability of occupation by the target of different twenty-five-yard zones, when the brackets given have been determined by observation of bursts (1) in the plane of site and (2) two mils above the plane of site. Computations were made by Capt. L. J. McNair, Fourth F. A., and are based on probability tables for the three-inch field gun computed from firings at the School of Fire.

Inferior limit of each 25 yd. zone for height of burst, mils		Bracket, yards								
		100			200			400		
		2000–2100			2000–2200			2000–2400		
		Number of rounds, fired with same data, observed at each limit								
0	2	1	2	4	1	2	4	1	2	4
1875	1825	.001			.001					
1900	1850	.006			.002			.001		
1925	1875	.018	.002		.008			.004		
1950	1900	.046	.016	.001	.021	.005		.010	.002	
1975	1925	.092	.062	.020	.043	.018	.003	.020	.007	.001
2000	1950	.149	.161	.133	.071	.050	.020	.033	.019	.006
2025	1975	.188	.259	.346	.100	.099	.076	.047	.038	.021
2050	2000	.188	.259	.346	.122	.155	.166	.057	.057	.048
2075	2025	.149	.161	.133	.132	.173	.235	.063	.069	.071
2100	2050	.092	.062	.020	.132	.173	.235	.065	.075	.084
2125	2075	.046	.016	.001	.122	.155	.166	.066	.077	.089
2150	2100	.018	.002		.100	.099	.076	.067	.078	.090
2175	2125	.006			.071	.050	.020	.067	.078	.090
2200	2150	.001			.043	.018	.003	.067	.078	.090
2225	2175				.021	.005		.067	.078	.090
2250	2200				.008			.066	.077	.089
2275	2225				.002			.065	.075	.084
2300	2250				.001			.063	.069	.071
2325	2275							.057	.057	.048
2350	2300							.047	.038	.021
2375	2325							.033	.019	.006
2400	2350							.020	.007	.001
2425	2375							.010	.002	
2450	2400							.004		
2475	2425							.001		
2500	2450									
For bracket		.674	.840	.958	.850	.954	.994	.930	.982	.998
		4000–4100			4000–4200			4000–4400		
3875	3825	.003			.001			.001		
3900	3850	.009			.004			.002		
3925	3875	.024	.005		.011	.001		.005		
3950	3900	.052	.022	.003	.025	.006		.011	.002	
3975	3925	.095	.071	.028	.045	.022	.004	.021	.008	.001
4000	3950	.142	.160	.144	.071	.054	.022	.033	.020	.006
4025	3975	.175	.242	.325	.097	.100	.078	.046	.037	.020
4050	4000	.175	.242	.325	.118	.145	.164	.055	.055	.044
4075	4025	.142	.160	.144	.128	.172	.232	.062	.067	.068
4100	4050	.095	.071	.028	.128	.172	.232	.065	.075	.084
4125	4075	.052	.022	.003	.118	.145	.164	.066	.078	.090
4150	4100	.024	.005		.097	.100	.078	.066	.079	.093
4175	4125	.009			.071	.054	.022	.067	.079	.094
4200	4150	.003			.045	.022	.004	.067	.079	.094
4225	4175				.025	.006		.066	.079	.093
4250	4200				.011	.001		.066	.078	.090
4275	4225				.004			.065	.075	.084
4300	4250				.001			.062	.067	.068
4325	4275							.055	.055	.044
4350	4300							.046	.037	.020
4375	4325							.033	.020	.006
4400	4350							.021	.008	.001
4425	4375							.011	.002	
4450	4400							.005		
4475	4425							.002		
4500	4450							.001		
For bracket		.634	.804	.938	.828	.942	.992	.920	.980	.998

USE OF THE BATTERY DETAIL IN THE RECONNAISSANCE AND OCCUPATION OF POSITION.

The method of using the battery detail in the reconnaissance, selection, and occupation of a position must be sufficiently flexible to be adapted to varied conditions and circumstances. However, for training the detail a carefully planned "model method" can profitably be used, else a resulting lack of system or method will fail to accomplish satisfactory results. Such a "model method" is outlined below.

Three blasts on the whistle is the signal for the detail to leave the column and to report, equipped, to the battery commander. If necessary, the chiefs of platoon repeat this signal. As the detail rides up to report, it is formed by the Instrument Sergeant, and then reported by him to the Battery Commander. When ready to proceed on the reconnaissance the Battery Staff has assumed the following formation from front to rear.

	✤	Battery Commander.
	✤	Orderly.
Scout No. 2.	✤ ✤	Instrument Sergeant.
Telephone corporal.	✤ ✤	Range Finder.
Operator No. 1.	✤ ✤	Scout No. 1.
	✤	Operator No. 2.
	✤	First Sergeant.

If the Battery Commander desires to verify the detail he commands, "Call Off." The detail calls off in the following order from rear to front:

First Sergeant.
Operator No. 1.
Operator No. 2.
Telephone Corporal.
Scout No. 1.
Scout No. 2.
Range Finder.
Instrument Sergeant.
Orderly.

In battalion work the agent reports to the battery commander before leaving park and remains with him until the battery is re-

ported in order when he is sent to report to the Battalion Commander.

The instrument sergeant is responsible that the route is marked beyond a question of doubt. Should he be uncertain as to when this is to be done or on any point in connection therewith, he asks the Battery Commander for information.

To mark the route the instrument sergeant calls "Marker" at the points where he desires the same placed, and members of the detail drop off at this command in the order:

Operator No. 1.
Operator No. 2.
Telephone Corporal.
Scout No. 1.
Scout No. 2.
Range Finder.

This is the order in which these members of the detail call off.

The route is marked by the relay method, that is, Operator No. 1 relays from battery to Operator No. 2; Operator No. 2 from Operator No. 1 to Telephone Corporal, and so on.

If available two or more caisson corporals can profitably be used as connecting files between the battery and the first marker, Operator No. 1. They thus act as ground scouts, by selecting the best road for the battery to pass over, and at the same time afford opportunity for Operator No. 1 to keep considerably closer to the detail.

The instrument sergeant is always responsible that the detail, when together, rides at a collected and orderly gait and keeps a reasonable distance (at least 20 yards) behind the Battery Commander.

On approaching a position, the detail drops behind the Battery Commander, and the instrument sergeant is responsible for keeping the detail under cover whenever cover is available. Whenever necessary, the instrument sergeant will himself be the connecting link between the Battery Commander and the other members of the detail. He will not lose sight of the battery commander, nor will Scout No. 2 permit the remainder of the detail to lose sight of the instrument sergeant. Ordinarily it will be possible for the detail to halt together in rear of the crest while the battery commander rides forward to make the reconnaissance. As a usual

thing, the battery commander, before he becomes exposed, will dismount. The orderly, who remains behind, is instructed to watch the Battery Commander and when the latter is about to dismount, he rides up to take the horse. In doing this he comes up on the right of the Battery Commander's horse, and without dismounting takes the reins as they are passed to him. This method puts the off side of the Battery Commander's horse next to the orderly and leaves the near side free for quick and convenient mounting.

On completing this reconnaissance the Battery Commander calls "Detail," or signals by three blasts on the whistle. At this command or signal the instrument sergeant, Scout No. 2 and the range finder dismount. Scout No. 2 passes the reins of his horse to the telephone corporal who rides up on his left. The range finder links his horse to Scout No. 2's horse. The instrument sergeant links his horse to the range finder's horse.

These three men, having dismounted and turned over their horses to the telephone corporal, approach the selected Battery Commander's position, being careful to do so at sufficient intervals, so that if discovered by an observing enemy they will present the appearance of Infantry rather than that of a battery staff. The Battery Commander then indicates to them:

1. The situation or problem.
2. The sector with the location of the enemy and friendly troops.
3. The reference point and the target if known.
4. The general location of the Battalion Commander's station.
5. The approximate position of the guns.
6. The aiming point.
7. Kind of communications.

If the Battery Commander fails to give all of this, or any other necessary information, it is asked for.

The Battery Commander then proceeds (mounted or dismounted) to reconnoiter the gun position. In the mean time the instrument sergeant and the range finder set up their instruments, taking the maximum degree of cover which the position affords, and compute the data for the target or targets, or for prominent points within the sector. Scout No. 2 from a well concealed place observes the target, looks for other targets within the sector, and unless otherwise employed makes a panoramic sketch of the sector.

The remainder of the detail, keeping under cover, follow the

Battery Commander in the following order to the vicinity of the gun position:

	Battery Commander.
	Orderly.
Operator No. 1.	Scout No. 1
First Sergeant.	Operator No. 2.
	Telephone Corporal with led horses.

When the Battery Commander calls out "Gun Markers," Operator No. 1 and Scout No. 1 dismount, turning over their horses to Operator No. 2, who for this purpose rides up on the right of Scout No. 1.

The telephone corporal at once asks what kind of communication to establish, and where to take the led horses, whereupon he and Operator No. 2 dispose of the horses by taking them to the designated place and linking them two and two, head to tail. These men then hurry back to establish the kind of communication ordered.

The Battery Commander marks either the right or left gun with Scout No. 1 or Operator No. 1, and places the other one on the line. In order to aid the Executive Officer the man who marks the right or left gun, faces in the direction of fire with one arm extended in that direction, and the other extended in the direction of the line of guns.

If not made known to them, Scout No. 1 and Operator No. 1 will ask:

1. Kind of communication.
2. The aiming point.

If necessary the battery commander, accompanied by the orderly and first sergeant, rides to reconnoiter a position for the limbers. The Battery Commander informs the first sergeant:

1. The aiming point.
2. The position of the limbers.
3. Gait for the battery to use in approaching the position.
4. Any necessary instruction relative to the formation and manner in which the battery should approach and occupy the position.

The first sergeant will ask for information covering any or all of these points if same is not made clear to him. He then reports back to the Executive Office with this information, and leads the battery up to the position.

As an example, to emphasize clearness and brevity, the Battery Commander says to the first sergeant:

"Aiming point; Signal Mountain; place the limbers behind that clump of woods; bring the battery up in double section column at a trot, halt at this point, dismount the drivers; approach the position from the left, go column right, then action left."

When the first sergeant has received his instructions the Battery Commander rides to the vicinity of the Battery Commander's station and turns over his horse to the orderly. The latter then goes to the position of the horses belonging to the detail and takes charge of them.

When telephone or buzzer communication is used, the telephone corporal sees that Operator No. 2 runs out the wire by beginning either at the Battery Commander's station, or the position of the battery, depending upon which is nearer to the place where he left the horses. Ordinarily the wire is run out so as to leave the reel with Operator No. 1 at the position of the battery. This permits the buzzer at the Battery Commander's station to be plugged in and gotten ready for operation, and affords the Executive Office latitude in placing his telephone without interfering with the instrument at the Battery Commander's station. When command "close station" is given, the wire is reeled up by the operator who has the reel. The telephone corporal carries the Battery Commander's megaphone, and Operator No. 1 carries the one for the Executive Officer.

With obvious modifications the gun position may be selected before the Battery Commander's position, or both may be designated by the Battery Commander to the entire detail, before or during the reconnaissance.

It must not be lost sight of that the whole detail should work together as a team. Each man has his particular part to play but must stand ready to assist, or take the place of, any man who falls out of the team. Every member of the detail should therefore be fully trained in all the duties of the other members.

In general, and as a summary, duties are assigned as follows:

Instrument Sergeant.

1. In general charge of the instruments and equipment used by the detail.
2. Forms and commands the detail.

3. Sees that the route is marked.

4. Keeps detail under cover when approaching or in vicinity of position.

5. Learns from the Battery Commander:

(a) The situation or problem.

(b) The sector, with the location of the enemy and friendly troops.

(c) The reference point and the target if known.

(d) The general location of the Battery Commander's station.

(e) Position of the guns.

(f) The aiming point.

(g) Kind of communications.

(h) Other necessary information depending upon circumstances.

6. Sets up the Battery Commander's telescope taking as much advantage of cover as the general location of the Battery Commander's station affords.

7. Computes the firing data.

8. During firing, keeps the firing record and renders the Battery Commander as much assistance as possible in observing the fire, and collecting, recording and transmitting data.

Range Finder.

1. Responsible for the condition and care of the range finding instrument.

2. Acts as road marker.

3. Operates the range finder and assists the instrument sergeant in computing the firing data.

Scout No. 2.

1. Acts as road marker.

2. Learns from the Battery Commander or instrument sergeant:

(a) The situation or problem.

(b) The sector, with the location of the enemy and friendly troops.

(c) The target.

3. Observes the sector, keeps target under observation reporting change, disappearance, reappearance, movement or destruction.

4. Draws panoramic sketch of sector and keeps such data as may be required by the instrument sergeant.

Scout No. 1.

1. Acts as road marker.
2. Marks line of guns.
3. Learns from Battery Commander:

   (a) Direction of fire.
   (b) Aiming point.
   (c) If he is to make a flank gun.
   (d) Kind of communications.

Telephone Corporal.

1. Under general supervision of the instrument sergeant, he has charge of and is responsible for all the signal equipment of the battery. He makes such tests and repairs as he is authorized to make, and reports all trouble which he cannot remedy to the battery commander personally at the first opportunity.

2. Acts as road marker.

3. Asks Battery Commander where to place the horses of the detail and is responsible that they are secured in that place.

4. Asks Battery Commander kind of communication to establish, and is responsible that same is established quickly and efficiently.

5. Acts as operator at Battery Commander's station on the battalion line.

6. When verbal communications are used, he may be required to transmit or relay the commands of the Battery Commander to the battery.

7. Reports to instrument sergeant or Battery Commander—"Communication with Battalion Commander's station established;" or "communication with battery established;" when same has been established. He also reports any break occurring in the communication with the battalion station or with the battery.

Operator No. 2.

1. Acts as road marker.

2. Assists the telephone corporal in placing and linking the horses of the detail.

3. Under direction of the telephone corporal establishes the kind of communication ordered, and acts as operator at the Battery Commander's station.

Operator No. 1.

1. Acts as road marker.
2. Marks line of guns.
3. Learns from Battery Commander:
   (a) Direction of fire.
   (b) Aiming point.
   (c) If he is to mark a flank gun.
   (d) Kind of communication.
4. Assists in establishing the kind of communication ordered, and acts as operator at the battery.
5. Reports to Executive Officer—"Communication with Battery Commander's station established;" when same has been established. He also reports any break which occurs in the communication with the Battery Commander's station.

First Sergeant.

1. Learns from the Battery Commander:
   (a) Aiming point.
   (b) Position of limbers.
   (c) Gait of battery to use in coming up to the position.
   (d) Battery Commander's instruction relative to manner of coming into the position.
2. Leads the battery into the position selected.

Orderly.

1. Acts as horseholder for the Battery Commander.
2. Watches, or assists in holding all the horses belonging to detail.

Agent.

1. Acts as agent between the Battalion Commander and the Battery Commander.

EQUIPMENT CARRIED BY MEMBERS OF DETAIL.

Members	Field Glasses	Telephones	Semaphore Kits	Hand Reel and Spool of Buzzer Wire	Megaphone	Battery Commander Telescope	Battery Commander Ruler	Note Book and Pencil	Data Book	Buzzer Record Book
Orderly.....										
Instrument Sergeant.	X		X			X	X	X	X	
Range Finder....								X		
Scout No. 2.....	X		X					X		
Scout No. 1.....	X		X					X		
Telephone Corporal.	X	X	X		X			X		X
Operator No. 2...	X	X	X	X				X		X
Operator No. 1...	X	X	X		X			X		X
1st Sergeant.....	(Ought) to have) X							X		
Agent.....	(Ought to have) X		X					X		

When for any reason the number of men in the detail is reduced, the duties may be distributed as follows:

DISTRIBUTION OF DUTIES.

Members Retained	Instrument Sergeant	Range Finder	Scout No. 2	Scout No. 1	Telephone Corporal	Operator No. 2	Operator No. 1
Instrument Sergeant.. Range Finder..... Scout No. 2..... Scout No. 1..... Telephone Corporal.. Operator No. 2.....	Same	Same	Same	Same Operator No. 1	Same	Same	
Instrument Sergeant.. Range Finder..... Scout No. 2..... Scout No. 1..... Telephone Corporal...	Same	Same	Same	Same Operator No. 1	Same Operator No. 2		
Instrument Sergeant.. Range Finder..... Scout No. 2..... Scout No. 1.....	Same	Same	Same Tel. Cpl. Operator No. 2	Same Operator No. 1			
Instrument Sergeant.. Scout No. 2..... Scout No. 1.....	Same		Same Range Finder Tel. Cpl. Operator No. 2	Same Operator No. 1			

(School of Fire for Field Artillery. February, 1915.)

EDITORIAL DEPARTMENT

Our Deficiency in Field Artillery Troops.

From the fall of Liége to the present day every report from the European war has forced home the fact that this is a field artillery war, and that, from a military view-point, we are living in a field artillery age. The experiences of these European campaigns are graphic proofs that the old-time faith in fortresses is a thing of the past, and that any force which relies upon a fortress as a point of support without sufficiently covering it with a mobile force condemns itself to defeat and utimately to destruction or surrender. These are days of mobile armies; and the victorious ones are well-supplied with field artillery.

In the light of this knowledge, it is necessary for us to consider carefully our own lack of field artillery preparedness. Our deficiencies are easily ascertained, and are appalling. Such is our lack of field artillery that recenty one-half the horse artillery and one-half the heavy artillery of the entire United States Army was concentrated at Naco, Arizona, as the result of a trifling incident of border warfare.

The information contained in Major Edward P. O'Hern's article in the present issue of the FIELD ARTILLERY JOURNAL is to a certain extent reassuring as far as matériel and ammunition is concerned. The project falls far short of what is required, but it is encouraging in that it is based upon a progressive foundation and is constantly being improved. But we should bear in mind that to appropriate money for guns and ammunition and to manufacture them and store them in arsenals is not to increase the field artillery strength of the nation. Batteries cannot be created by a stroke of the pen. No matter how powerful nor of how modern design they may be, field guns are no better than wooden dummies unless they are served by trained men, commanded by trained officers, and transported by either trained teams or efficient tractors. Without this trained personnel and adequate transportation, artillery is a mill-stone about the neck of a commander. A gun mired in the road for lack of a good team and trained drivers is an obstruction, not an asset. A battery badly located is a source of danger, not a protection.

In his annual report as chief of coast artillery for the year 1908, Major General Arthur Murray referred to the need of additional field artillery in the following words:

In closing my last report upon the field artillery I wish to express my conviction that the interests of the national security demand an increase in the strength of that arm. The wider and more important rôle now open to the field artillery, the admitted futility of looking to the militia for any material number of efficient batteries, the impracticability of forming efficient organizations from raw material after the outbreak of war, and the fact that the present strength of the field artillery is little more than half that required to furnish the proper quota for the mobile army as now organized, all these considerations show the imperative necessity for increasing the strength of this arm.

The present Field Service Regulations prescribe the organization of a division and the strength of the different arms composing it. On the basis therein prescribed, which is that followed by other armies, our infantry and cavalry would provide three and a third divisions of infantry and one cavalry division and would call for six regiments of light and mountain artillery and one of horse, plus the artillery for the extra one-third division (calling for two-thirds of a regiment of artillery). From which it is seen that we are one and two-thirds regiments short of the allowance prescribed by Field Service Regulations for divisional artillery for the army's present strength. But an even graver condition exists—the allowance above noted gives a proportion of about 3.35 guns per thousand bayonets, and it is evident that this amount should be entirely devoted to light, mountain, and horse artillery.

Including heavy field artillery, but not including guns of position, the proportion of guns to infantry varies in France, Austria, Russia, England, Japan and Germany from about 4.5 to over 6.

Moreover, it must be borne in mind that the militia is deficient in numbers, organization, and training of field artillery as compared with the other arms, and that there is no way of expanding the field artillery. This can only be done by adding guns to batteries, for there is no power to add *a single battery;* but this addition of batteries is the only practicable way to increase the number of our guns, for our batteries already contain fully as many pieces as a captain can efficiently handle. War expansion with a rapid-fire battery must take the form not of adding guns, but of adding caissons to the already existing guns.

It is evident that the only possible means of remedying this condition is an increase of the field artillery. Our army, though small, should be efficient. No army can now be efficient that is as badly deficient in its quota of field artillery as is ours. Each succeeding war shows more clearly than its predecessor the importance of this

arm; and every improvement in the gun, its ammunition, or method of fire, makes still more impossible hasty improvization of field artillery.

The minimum allowable amount of field artillery for the army as at present constituted is shown by the following:

For 3½ divisions of infantry.—Six and two-thirds regiments of field artillery, manning light and mountain guns (24 guns to the regiment); 3 1-3 regiments of field artillery, manning howitzers and heavy guns (16 guns to the regiment).

For 1 cavalry divison.—One regiment of field artillery (horse); total, 11 regiments of field artillery.

This would give a proportion of about 4.42 guns to 1,000 bayonets and sabers, which is less than that of all other great powers, and would require an increase of five regiments. In other words, we have a little over half of the amount of field artillery that is absolutely necessary for our small Regular Army.

General Murray had devoted years to the study of artillery and to the consideration of artillery needs. Major General Leonard Wood, an officer without inherited prejudice in favor of any arm of the service, in a report submitted upon his retirement as Chief of Staff in April, 1914, stated that the immediate supply of the necessary field artillery troops, guns and ammunition constituted one of the four vital needs of the army. He recommended an immediate increase of the regular field artillery by twelve battalions. General Murray and General Wood are not alone in their opinion. Every discerning critic of our military establishment has commented upon our lack of field artillery. It is too self-evident a fact to be overlooked.

The deficiency in field artillery and the urgent need of an increase in the light and horse artillery and the creation of an adequate heavy artillery are matters of great concern to every officer of the Field Artillery, both in the Regular Army and in the Organized Militia. To what extent our officers have formulated and recorded their ideas it is impossible to determine; but it would be well if every officer were to consider that at any time he may be called upon to express an opinion on these vital matters, and that this opinion may, without his knowledge, have far-reaching effects. Certain definite recommendations for a reorganization of the field artillery have recently been made which we hope to include in some suitable form in the next issue of the FIELD ARTILLERY JOURNAL.

The Single List for Promotion.

From the point of view of military efficiency, the need of an immediate and substantial increase in field artillery troops is very generally recognized; but as a matter of present policy, it would appear that the outlook for such an increase is not encouraging. The reason lies in the fact that expediency and not efficiency seems inevitably to be the prevailing factor in any consideration of a proper organization for our military forces.

With the question of expediency in connection with public sentiment and legislative action along broad general lines we are not for the moment concerned; but with the question of expediency translated into terms of the promotion of officers we believe that every officer of field artillery should at this time be most vitally concerned.

The Report on the Organization of the Land Forces of the United States, published in 1912, is the only tangible expression of a military policy which exists today, and the only plan for the reorganization of our forces which bears the approval of the War Department. In its underlying principles and its general application of those principles it is so admirable and so worthy of support that it is considered most unfortunate that it should contain a provision designed to equalize the promotion of officers which is admittedly a compromise, which is based upon expediency, which strikes at the root of efficiency, and which recognizes amongst our officers the existence of partisanship and selfishness.

If the service at large desires the equalization of promotion in time of peace by the creation of a single list, or by resort to any other expedient which will produce this result and at the same time safeguard the efficiency of the Army, the Field Artillery should be the first arm cheerfully to lend its support to such a plan. For it is war and not peace which radically influences promotion; and if a single list were to be created, in war the Field Artillery would reap much rapid promotion by the sacrifice of officers of another arm. It is indeed strange that the Infantry, which is necessarily exposed to the greatest battle losses, should be willing to share with other arms the dearly bought promotion which must in war inevitably come to the survivor.

But whatever may be the effect of the single list upon equalizing promotion in the three arms, we believe that it would strike so deeply at the roots of efficiency as eventually to inflict great harm upon

the service. Our men are entitled to the leadership of trained officers. The lack of such leadership has greatly prolonged every war we have ever waged. It is impossible to imagine an officer of field artillery commanding a regiment of infantry or cavalry as efficiently as if he had been trained to such command. However broad his experience and education might have been, it would be at once apparent to the officers and men under his command that he was dealing with new problems and wielding strange weapons. In peace this would lead to a loss in efficiency only. In war not only efficiency but human lives and the outcome of battles would be put in jeopardy. Our distrust of the single list for promotion comes not so much from a feeling of reluctance to be commanded by officers of other arms as from a conviction that any officer, thoroughly trained in the mechanism of an arm in time of peace, should be privileged to command a unit of that arm in time of war, and should not be placed in a position where his inexperience with another arm might result in blunders which might neutralize its efficiency.

We should not be misled by approaching the problem in a spirit of subjective selfishness. Whether it will benefit us as field artillerymen or as individuals is not important. No reorganization can be effected without producing temporary inequalities in promotion. War is the great leveler; and in war temporary inequalities caused by legislation will be swept away. If any given reorganization is designed to produce an efficient, well-balanced military force for the defense of the nation, it should be put into effect regardless of the fortunes of any individual or of any arm.

We believe that this plan, like every other provision for military reorganization, should be considered not upon a peace basis but upon a basis determined by war conditions as nearly as those conditions may be ascertained or foretold. Under war conditions we believe that the single list will not equalize promotions, and will not make military rewards follow military sacrifices. We believe that, in both war and peace, it will reduce the efficiency of every arm of the service.

Coast Artillery Corps and Heavy Field Artillery Matériel.

Each arm of the service was created in order that it might perform some primary function, the need of which is vital to the defense of the nation and which cannot be equally well performed by any other

arm. In grave emergencies, or when there is no opportunity for the performance of this primary function, any portion of the Army may be assigned temporarily to any other duty which it is capable of performing.

In order to carry out this idea of necessary specialization, the Field Artillery and the Coast Artillery were made separate arms by the Act of January 25, 1907. By this act the Coast Artillery was "charged with the care and use of the fixed and movable elements of land and coast fortifications, including the submarine mines and torpedo defenses." By the same act the Field Artillery is designated as "the artillery which accompanies an army in the field and includes light artillery, horse artillery, siege artillery, and mountain artillery." From the wording of the law, there would appear to be no doubt as to the primary service which these two arms are intended to render to the country.

Due, however, to the alarming shortage of field artillery troops at the time when the Mexican situation first became critical, it was deemed expedient by competent authority to issue to certain coast artillery troops a limited number of batteries of what was formerly known in our service as "siege artillery." This consisted of 5-inch and 7-inch "siege" matériel.

But this assignment of coast artillery troops to what is manifestly a secondary service must be recognized only as a temporary expedient forced upon the War Department by the lack of the necessary field artillery personnel. The legality of this procedure is covered by the following provision of the Army Reorganization Act of February 2, 1901, which has never been specifically repealed:

> SECTION. 4. *Provided*, That this shall not be construed to limit the authority of the Secretary of War to order coast artillery to any duty which the public service demands, or to prevent the use of machine or other guns by any other arm of the service under the direction of the Secretary of War.

This use of the Coast Artillery is comparable to the service which it has performed in the past as extemporized infantry. In the same manner it is conceivable that infantry or engineer troops might in an emergency be assigned to perform such artillery duties as they could temporarily be able to adapt themselves to. Versatility and ability to do unfamiliar work at a critical time has always been an attribute of the American soldier.

But recently there have been noted indications of a desire to consider the field artillery and infantry duties which the Coast Artillery might in exceptional cases be called upon to perform not as secondary service incident to an emergency but rather as sub-divisions of their primary service. Matériel designed primarily as heavy field artillery, guns and howitzers of the latest design, have been issued to the Coast Artillery. This matériel is not in any sense of the word "siege artillery," nor is it "position artillery." It bears no relation to the large caliber guns and howitzers which the present European war have brought into prominence. It is heavy field artillery, designed to "accompany an army in the field" and capable of great mobility when properly manned and horsed. Its manufacture and issue were amply justified and greatly needed; but if it is to be employed at its maximum efficiency, field artillery troops should be provided for its service. The fundamental difference between field and coast artillery service was recognized in the Act of January 25, 1907; the separation of the two arms has increased the efficiency of both; and nothing has occurred to indicate that recent developments have in any way changed the situation.

This position does not rest upon selfishness nor upon partisanship. It is taken because of a sincere conviction that the military needs of the nation can best be provided for by a logical assignment of tasks to the various arms of the service, and that for this reason the excellent work which the Coast Artillery are doing in their own field should not be neutralized by directing a portion of their efforts toward the work of any other arm except as a temporary expedient resorted to in an emergency. Maximum efficiency cannot be separated from primary service.

"The Problem of Our Coast Defense."

The publication in the February number of the *North American Review* of an article by 1st Lieutenant Marcellus H. Thompson, Coast Artillery Corps, entitled, "The Problem of Our Coast Defense," is significant of an awakened public interest in the many-sided question of national defense.

Lieutenant Thompson has presented but one phase of the question. He has made a very creditable special plea for the needs of his own corps, and has made clear many technical points in connection with the rivalry between ships and forts upon which the general public

and many officers of other arms were undoubtedly not well informed.

Although nothing can be said to dispute the accuracy of Lieutenant Thompson's statements, we cannot refrain from suggesting that he leaves his readers with a conviction that if an adequate harbor defense be provided the country will be secure. He necessarily gives the Navy its proper share in coast defense, but he seems gracefully to pass over the fact that our so-called coast defenses are but harbor defenses, and that the coast cannot be fully guarded except by efficient cooperation between the Navy and the coast artillery, *supported by an adequate mobile force.* A great estate is not safe simply because the lodge gates and the front door are locked. The thieves may not decide to come in that way.

The true significance of harbor defenses is admirably brought out by Colonel Robert Foster, R. E., in his book entitled "The Principles of Imperial Defense," to which reference is made in the book reviews in this issue of the FIELD ARTILLERY JOURNAL; but probably no recent expression of opinion on this subject has created so much interest or has been received as so convincingly authoritative as Major General John P. Story's recent letter to the editor of the *Army and Navy Register.* As ex-Chief of Artillery and a recognized expert or coast defense, General Story is prepared to speak with authority. His presentation of the case is admirable, and his arguments unanswerable. He points out beyond the peraventure of a doubt that the most elaborate coast defenses are useless expenditures of public funds unless provisions are also made to cover them from attacks in rear by an adequate *mobile force.*

The text of his letter is as follows:

COAST DEFENSE.

[To the Editor.]

LOS ANGELES, CAL., Jan. 22, 1915.

Sir: In the discussion of military preparedness in the United States an exaggerated importance has been attached to the fact that the latest naval high-powered guns are superior in fire to the standard 12-inch rifle in our coast defenses. The principal elements of coast defense against direct naval attack are gunfire, motar fire, anchored mines, floating mines, torpedo boats, and submarines. The efficiency of the four elements last named are not specially affected by any superiority in naval gunfire. I omit air crafts from consideration, as their military value has not yet been determined.

It is safe to say the hostile vessel beyond the range of land guns is not immune from destruction by other elements of coast defense.

At Port Arthur, after sinking of a Japanese war vessel by a floating mine, the Japanese fleet hid itself in a concealed base and did not again menace that port. Japan then established a rule of naval conduct which still holds, and no fleet will in the future, however powerful its armament may be, undertake a close blockade near coast defenses properly equipped.

In sea fortification, as a rule, the best guns are inferior to the best guns which may attack them, but this fact does not, to my mind, press for the immediate discard of inferior guns. There are too many other elements which neutralize the advantages of superior gunfire.

The standard gun in German seacoast defense is the 11-inch rifle. This gun is far outclassed by the best English naval ordnance; yet there is no suggestion that English war vessels shall bombard German forts at ranges beyond the limit of German gunfire. In this instance the superiority of English naval fire does not dominate the German sea fortifications.

With the exception of Los Angeles, there is no fortified harbor in the United States where I have not studied on the ground the means of coast defense. They all have a common weakness. A safe landing attack may be made by the enemy beyond the range of the permanent guns.

If in time of war our Navy should fail us and the enemy wish to capture one of our forts, it would take the path of least resistance, and this path will, in my judgment, be by making a land attack. Possibly not a hostile shot would be fired from our seacoast guns.

The crux of military preparadness in the United States is, first, naval defense and, that failing us, protection against landing attack.

J. P. STORY,
Major General, U. S. A., Retired.

The Demand for the Breast Collar.

There appears to be a sudden and almost unanimous desire on the part of the Field Artillery, both regular and militia, for the substitution of some device more suited for active service in the field than the present steel artillery collar. After twenty-two years of trial, the steel collar is at last found to be adapted most excellently to the requirements of well-instructed batteries in garrison, but absolutely unfitted for field use. The reasons leading to this conclusion as they appear to two experienced officers are well set forth in this issue of the FIELD ARTILLERY JOURNAL. These articles are all the more interesting because one of the writers has recently had excep-

tional opportunities of working with fourteen militia batteries in time of peace, and the other has recently had even more exceptional opportunities of seeing the horses of regular French batteries after their gruelling ordeal during the battle of the Marne. That they should both have independently and almost simultaneously come to the same conclusion in regard to the immediate necessity of looking at our harness exclusively from a war-service point of view is at least significant.

The collar used on artillery harness during the Civil War was made of stuffed russet leather. It was furnished in two sizes, 17-inch and 20-inch, and was stuffed with uncut straw. The hames were made of iron and painted black. There were two double joint loops for the trace tugs, which were attached to the hame branches by means of bolts passing through a stud forged on the branch. This collar was used until about 1890. In 1887, Major Edward B. Williston, 3rd Artillery (now Brigadier General, retired), after a test of various parts of the artillery harness which had been carried on for five or six years, reported on the collar as follows:

> The regulation collar is very objectionable. It fastens by means of straps at the top, just the place where it should be firm, consequently it is not always properly closed. The straps stretch and the holes for the buckle tongues become enlarged. Frequently the collar is not properly closed because circumstances prevent or the horse objects. Even under favorable circumstances, it is hard work for a short man to buckle the strap of the collar properly and if the horse is galled and restive or the harnessing is done at night, it is almost impossible to do so. . . .
>
> It does not seem to be necessary or desirable to have the hames separate from the collar. . . .
>
> It is believed that the best collar for artillery service is one hinged firmly at the top and fastening at the bottom with a spring catch, the hames to be permanently attached thereto. . . .

Major Williston then described a collar made according to his recommendation which had been in use in two light batteries since 1881. The collar hoods were made large enough to cover the hinge and protect the back of the neck. The collar was made of padded leather and was so arranged that the hames were permanently attached to it. This collar was adopted for the service; and the Chief of Ordnance, in his report for 1889, stated that it was a great

improvement over the Civil War collar, but intimated that it could be improved and lessened in weight by use of the steel collar.

Steel collars were issued in 1893 upon the recommendation of field artillery officers. Apparently they gave most excellent results under peace conditions, when their adjustment was made the subject of careful study and constant supervision on the part of officers. This clouded the issue and prevented officers from realizing that any part of our equipment which is satisfactory under peace conditions only should be at once either eliminated or modified. Troops of the line and their equipment should be subjected to but one test—that of readiness for war and war conditions.

About 1910 or 1911 sets of harness were procured from European countries in order to note the methods there employed. The French harness, embodying a leather breast strap instead of a collar, was favorably considered by many field artillery officers because of the lighter weight and the easier adjustment, notwithstanding the admitted loss of draft efficiency of about 10 per cent. A modified form of French harness was designed and manufactured by the Ordnance Department and issued to a battery of the 3rd Artillery and of the 6th Artillery. Reports on this harness were received in February, 1914. As indicated in Lieutenant Honeycutt's article in this issue, the reports were generally favorable to the adoption of the breast collar, after certain modifications had been made. The principal modification desired was in the method of sewing the breast strap and the addition of a pad to be placed on the horse's neck to carry the weight of the pole. After these modifications had been incorporated, the harness was again issued for further test, which is still being carried on.

Although this test is as yet incomplete, it is almost certain to result in the elimination of the steel collar. Whether the breast collar or the so-called "humane" collar is adopted in its place is a matter for appropriate action on the part of the Ordnance Department and the Field Artillery Board. The chief point to be considered is that we are at last beginning to look upon our training and our equipment from the view of field service under war conditions. That it took twenty-two years after the close of the Civil War to discover the disadvantages of the old leather collar, and twenty-two additional years to discover that fire department conditions favoring the use of steel collars on horses in uniform condition

were not field artillery war conditions is a reflection not upon individuals but upon a system which looked upon routine life in the Regular Army as an end in itself rather than as a preparation for war.

The Field Artillery and the Army Service Schools.

In the January-March number of the FIELD ARTILLERY JOURNAL for 1913, Major Harry G. Bishop, 5th Field Artillery, called attention to the great opportunities for professional advancement and study which the Army Service Schools at Fort Leavenworth, Kansas, hold out to the field artillery officer. It is believed that attention should again be directed to these opportunities and advantages in order that we may not permit ourselves to become so absorbed in the congenial duties of our own arm as to be oblivious to the fact that artillery technique will be valuable in direct proportion to the tactical technique which directs and controls it.

Although as officers of field artillery we are always ready to assert that nothing in the whole range of military activity is so fascinating as field artillery work, and that the command of an efficient field battery is an assignment well-fitted to delight a soldier's heart, we must realize that, if we are never to get outside of and beyond our own shop, we are in great danger of becoming narrow-minded. No field artillery commander can afford to put himself in the position of being on the field of battle informed only as to the inner workings of his own arm, and unable to appreciate the methods of thought and the line of action of those who gave him his orders. His delight may be in his battery or his battalion; but his pride should forbid that he be a mere pawn. The mastering of his own arm should only whet his desire to learn the technique of the others, so that at some future time he may be able to command efficiently a force of all arms.

It is not generally well known to what a gratifying extent our field artillery representatives at the service schools have been successful in the keen competition which has always existed at Fort Leavenworth. Every field artillery officer who entered the School of the Line from 1907 to 1913, inclusive, graduated, a record possessed by no other arm of the service. Twenty per cent. of the field artillery were honor graduates, and 75 per cent. of our repre-

sentatives were designated for the Staff Class. These percentages are higher than those of any other arm. It is only in the proportionate number of officers attending the service schools that we are deficient; and this is a deficiency which it is hoped an aroused interest in the tactical handling of our own and other arms may soon remedy.

Joint Field Artillery Camps, 1915.

In continuation of the policy adopted in 1913 and 1914, the War Department is making timely preparations for the establishment of joint field artillery camps at Tobyhanna, Pennsylvania; Fort Riley, Kansas; Fort Sill, Oklahoma; Anniston, Alabama; Sparta, Wisconsin, and Sisson, California. At each of these camps there will be a school for officers and noncommissioned officers of the Field Artillery of the Organized Militia from June 1 to June 15. At the conclusion of the school, the various militia batteries will be given the privilege of attending the camp nearest their home stations, bringing with them only the personnel and the individual equipments. The regular batteries will furnish the field artillery matériel, horses and camp equipage.

This method of instructing militia batteries affords the maximum instruction with a minimum of expense. The geographical distribution of the camps makes it possible for each one of the sixty-five militia batteries to take advantage of this opportunity for intensive training. The advantages to be gained from the camps by the Field Artillery of the Organized Militia are obvious; and it is incumbent upon every militia officer who is designated to attend the school or to accompany his battery to one of the camps to prepare himself carefully for this duty and to be prepared to make the most of his opportunities.

Although the duties and obligations of militia officers are very plain and are generally well-appreciated, it is believed that some regular officers may not be fully aware of their opportunities in connection with these joint camps. We are not very far removed from the years when the Regular Army was a thing apart. In those years many Regular Army officers dropped easily and deeply into a groove resulting from the constant repetition of garrison duties. To some extent the legacy of those years is still with us; but if

we are to be worthy of our commissions we must completely divorce ourselves from any idea of separateness and self-sufficiency. We must realize that the Regular Army is but one component part of the military strength of the nation.

Nearly every intelligent critic of our militia organization has reached the conclusion that the system is fundamentally wrong, and that if it is to be corrected it must be entirely recast and made to depend upon the broad constitutional authority to "raise and support armies," and must not be left in the hands of forty-eight separate State governments. But until this change is made by appropriate legislative action, it is the duty of every officer of the Regular Army to do his share towards minimizing the weaknesses of the existing system and lessening the difficulties of the officer of Organized Militia. Field artillery officers who are assigned to duty at joint camps should consider themselves as privileged to play a very important part in the development of the latent military resources of the country. After having perfected their own professional training and made their batteries or battalions ready for active service, field artillery officers have no more important duty than doing everything in their power to instruct, to advise and to encourage their fellow workers who are faced with the almost unsolvable problem of filling their appointed places in the civil community and at the same time working toward the recruitment, administration, financial support and instruction of military organizations. It is a reflection upon the good sense of the nation that any body of men should be required to strive towards such an impossible ideal; but we should remember that in the very hopelessness of the task there lies another duty and another privilege for the Regular Army.

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Field artillery fire.—Suggestions as to the offensive moment in the field artillery. The importance of the intervention by aerial craft in the tactical and constructive sphere of artillery, especially of the field artillery with low trajectory. Militaer-Wochenblatt, October 6, 1914, pp. 2800-04. No. 131.

Field artillery fire.—Description of a slide rule for indirect fire. Directions for solving the problems propounded. Journal of the Royal Artillery, November, 1914, pp. 529-536.

Field artillery fire—France.—Terrible effect of new French shell. Missiles that kill without wounding. The latest horror in war. (In The North China Herald, Shanghai, 1914, Vol. CXIII, No. 2466, November 14, 1914, p. 485. AN8C. N8, v. 113.)

Field artillery matériel—France.—Francia. Datos sobre matériel de artilleria. (del Memorial de artilleria, August, 1914, Madrid.) The number of guns on hand and under trial, July 14, 1914, in France. (In Revista Militar, Buenos Aires, 1914, pp. 829-830. U6 A6 R45, v. xiii.)

Field artillery fire.—"The war in the air. How the aeroplane scounts direct artillery fire, and how they fight—Duels in the air-Aeroplanes vs. Zeppelins." Flying, December, 1914, p. 325.

Field artillery fire—Germany.—Fire; firing over own infantry and replenishment of ammunition (100); fire control (102). Replenishment of personnel and matériel (101). Change of position (101). Duties of different commanders (101-2) Wedels Taschenbuch, 1915, pages in parenthesis. U135 G3 W3.

Field artillery fire—Germany.—Effect of artillery fire. Wedels Taschenbuch, 1915, p. 107. Filed U135 G3 W3.

Fire effect—of artillery (107). Wedels Taschenbuch, 1915, pages in parenthesis. U135 G3 W3.

Heavy field artillery.—Thoughts about heavy artillery. Is the heavy horse suited for a campaign? Militaer-Wochenblatt, October 3, 1914, pp. 2778-2781. No. 130.

Heavy field artillery—Germany.—Heavy artillery of the field army in France and Germany. A discussion of the pro and con of its need in both armies. Artilleristische Monatschefte, September, 1914, pp. 173-179.

Heavy artillery—Germany.—Brief statement of German general headquarters on the effect of the 42-centimeter guns in the bombardment of Liege, and of other heavy ordnance. French Supplement 188, Internationale Revue, November, 1914, pp. 318-319.

Heavy artillery—Russia.—Russia's artillery. Modernization of the heavy gun. By Arnold Louis Chevallier. A general article upon the Russian heavy artillery stating that it has outclassed the German artillery and the reasons therefor. Gives operation of the breech mechanism, description of the shrapnel, number of rounds carried on caisson, weight of gun, range and velocity. Illustrated. Illustrations are general in character. No details. (In Navy and Army Illustrated. London, 1914, Vol. II, No. 18, December 19, 1914, pp. 253-257.

Howitzers—Austria.—Short description and illustration of a new 6-inch howitzer. The Illustrated London News, November 28, 1914, p. 748.

Howitzers—European War, 1914.—Illustrations of howitzers of 12-inch caliber equipped for road transport, with brief description. Journal of the Royal Artillery, November, 1914, p. 561.

Howitzers—France.—Description and cuts of 120-millimeter French howitzer. The Engineer, December 11, 1914, p. 562.

Howitzer—Germany.—Description and illustration of the 42-centimeter gun. The Engineer, November 20, 1914, p. 480. Also Illustrated London News, November 21, 1914, p. 695.

Howitzers—Germany.—German press clippings on the 42-centimeter howitzer and artillery in general. Filed Env. Case—Howitzers—Germany.

Howitzers—Germany.—German artillery in the war, from the Scientific American. A fairly good description of the 11-inch Krupp howitzer, giving transportation, powder charges, range with different degrees of elevation, initial velocity, weight of projectile, and the recoil mechanism. Two illustrations showing method of transportation. (In Journal of the Military Service Institution of the United States, New York, 1914, Vol. 55, No. 192, November-December, 1914, pp. 485-487. U1 J5 Vol. 55.)

Howitzers—Germany.—The German 28-centimeter howitzer; its range and possibilities. Eight illustrations showing princpally the method of transporting and assembly. Text gives general description of the howitzer. (In Navy and Army Illustrated, London, 1914 Vol. 2, December 5, 1914, pp. 174-176, Illustrated.

Howitzers—Germany.—Germany's large howitzers. A portion of a letter to the Times, by General Sir Desmond O'Callaghan, late R. A., and chairman of the Ordnance Committee. Mentions 28- and 42-centimeter guns, with reference to platforms, transportation, weights, elevation, range, and bursting charge, also weight of shell. (In Arms and Explosives, London, 1914, Vol. XXII, p. 168, December 1, 1914. U2 A6 V. 22.)

Howitzers—Germany.—The big guns of the enemy. The great 42-centimeter German howitzer and the Austrian mortar gun described. Halftone illustrations showing methods of transport, etc. (In The Sphere, London, 1914, Vol. LIX, No. 28, 1914, pp. 210-210a, illustrated.)

Howitzers—Japan.—At Tsing-Tau; a Japanese 6-inch howitzer—the gunners being told not to let it be photographed. (In Illustrated War News, London, 1914, Part 17, December 2, 1914, p. 8. Illustrations only.)

Losses—European War 1914 (Germany).—Casualties of German artillery. According to the Prussian lists, 1-20; according to the Bavarian lists, 1-5; according to the Saxon lists, 1-6; according to the Wuertembergian lists, 1-8. Artilleristische Monatshefte, September, 1914, p. 216.

Mechanical transportation—France.—Report on results obtained in trials with motor trucks in France, by General Rohne. Brief data on efficiency demonstrated in comparison with animal traction. Artilleristische Monatshefte, September, 1914, pp. 204-213.

Mortars—Germany.—Two abandoned German mortars captured by the British from the flooded trenches near Pervyse. (In Navy and Army Illustrated, London, 1914, Vol. 2, December 5, 1914, p. 263, illustrated.)

Mortars—Germany.—German short-range mortars captured in Flanders. Illustration showing two mortars. (In The Scientific American, New York, 1915, Vol. CXII, No. 2, January 9, 1915, p. 55. T1.S5 V. 102.)

Mortars—Germany.—Information and view of German trench-mortar throwing 187-pound mine shell. The Illustrated War News, November 18, 1914, p. 38.

Mortars—Germany.—German 21-centimeter mortars, range finder and observation ladder pictured. Caterpillar wheels travel on mats. Clipped from German newspaper, November 12, 1914. Filed: Artillery material—Germany.

Mortars and Howitzers.—Detailed description with illustration of the Krupp 42-centimeter howitzer and with altered trail. Artillerie. (In Schweizerische Militär-Zeitung, 1914, pp. 393-398.)

Mountain artillery—France.—War organization of a mountain brigade. Wissen und Waffen, 1915, p. 1. U103 G3 W8.

Periscope.—The land periscope; a German observing with a periscope. (In Illustrated War News, London, 1914, Part 11, December 2, 1914, p. 46, illustration only.)

Range finders, Barr and Stroud.—Notes on the use of the Barr and Stroud range finder as a traversing instrument. The Royal Engineers Journal, January, 1915, pp. 25-26.

Range finders (Barr and Stroud).—Described and its use in night firing. Journal of the U. S. Cavalry Association, November, 1911. Filed UE1 J8.

Reconnaissance, aerial.—"Duncan" silver medal essay, 1914, from The Journal of the Royal Artillery, by Major H. Rowan-Robinson. Reconnaissance by aircraft. Artillery against aircraft. Rôle of aircraft, gunnery problems, and equipment and organization for the artillery. (In Journal of the Military Service Institution of the United States, New York, 1914, Vol. 55, No. 192, November-December, 1914, pp. 437-453. U1 J5 V. 55.)

Reconnaissance, aerial—France.—"War experiences of an air scout." A battle in the clouds. Scientific American, January 9, 1915, p. 51.

Schneider & Cie.—Matériel de campagne a tir rapide de 75 M/M type P. D., 1908. UF570 S 32 75-mm. A3. 1908.

Schneider & Cie—Matériel de debarquement de 76 M/M modele M. C. 5, 1910. UF570 S32 76-mm. A3, 1910.

Schneider & Cie.—Matériel de montagne puissant a tir rapide de 75 M/M type. M. P. D5, 1911. UF580 S32 75-mm. A3, 1911.

Schneider & Cie.—Matériel de montagne a tir rapide de 75 M/M type N. D. 1909. UF580 S32 75-mm. A3, 1909.

Schneider & Cie—Matériel de siege a tir rapide de 150 M/M modele S. C. No. 2, 1910. UF600 S 32 150-mm. A3, 1910.

Shrapnel.—"Shrapnel": The history of the terrible man-killing projectile. The story of Henry Sharpnel. The early use, reward of the inventor, etc. What it is. (In The War. Nelson's Picture Weekly. London, 1914. No. 8, October 10, 1914, pp. 16-17.)

Siege guns.—Are fortresses valueless? By Maurice A. Gerothwohl. The writer thinks that if forts are provided with large caliber guns they are still valuable. Examples given show that Antwerp was provided with 5.5-inch Krupp guns, and Verdun equipped with 12.2-inch. (In The Fortnightly, New York, 1914, November, 1914, pp. 846-853.)

Siege artillery fire—France.—French fortress artillery. Officers watching effect of fire from an observation ladder. One illustration. In The Times history of the war. London, 1914, Vol. 1, Part 7, October 6, 1914, p. 252.)

Siege guns—Germany.—An illustration of a German siege gun. (In The Times history of the war. London, 1914, Vol. 1, Part 6, September 29, 1914, p. 216.)

Siege guns—Germany.—One of the great siege guns used by the Germans. (In The American Review of Reviews, New York, 1914, Vol. L, November, 1914, p. 518, illustrations.) Probably 42-centimeter.

Siege guns—Germany.—Plate representing a Krupp 12-inch 45-ton naval gun mounted on railroad track for use as a siege gun. Descriptive data. Journal of the Royal Artillery, November, 1914, pp. 567-568.

Siege artillery—Germany.—Descriptive data on German siege batteries and explosives used by German forces. Army and Navy Gazette, November 28, 1914, p. 993.

Sights—Germany.—Description and drawings of panorama sight mounted on heavy German field howitzer. The Illustrated London News, November 14, 1914, p. 658.

Siege warfare—Germany.—Method employed by different arms of service. Weekly Times, London, 1914, p. 89, 105. Illustrated.

Transportation—European War, 1914.—A road smashed up by shell fire to make it useless for motor transport; a continuation of craters formed in the highway by British artillery to stop the enemy's advance. (In Illustrated War News, London, 1914, Part 17, December 2, 1914, pp. 30-31, double illustration only.)

Turpinite.—France's terrible new explosive. Mr. A. A. Roberts, chemist, writes about Turpinite, an explosive invented by M. Turpin, a French chemist. States that it must be used in guns of special construction, also the handling is confined to specialists. Produces instantaneous and absolutely painless death. (In the New War Encyclopedia and Dictionary, London (1914?), p. 85. D525.N53.)

Transportation, guns—Germany.—The German 28-centimeter howitzer; its range and possibilities. (In Navy and Army Illustrated, London, 1914, Vol. 2, December 5, 1914, pp. 174-176, illustrated.) Eight illustrations, showing principally the method of transporting and assembly. Text gives a general description of the howitzer and shell.

Transportation, guns—Germany.—Germany's large howitzers. A portion of a letter to The Times, by General Sir Desmond O'Callaghan, late R. A., and chairman of the Ordnance Committee. (In Arms and Explosives, London, 1914, Vol. XXII, p. 168, December 1, 1914, U2 A6 V. 22.) Mentions 28- and 42-centimeter guns, with reference to platforms, transportation, weights, elevation, range and bursting charge, also weight of shell.

BOOK REVIEWS.

Notes on Field Artillery, 2nd Edition. By Capt. Oliver L. Spalding, Jr., 4th Field Artillery. Published by United States Cavalry Association, Fort Leavenworth, Kans. 1 vol., 8 vo. Price, $1.25.

Captain Spaulding needs no introduction to the service, his excellent work as instructor in the service schools at Fort Leavenworth as well as his authorship of the first edition of the present volume, long a text book at the School of the Line, having long ago established him as an authority on Artillery matters.

The present edition is a revision and amplification of its predecessor and brings the subject down to the moment. It is written in the admirable style that characterizes all of the author's work, clear and concise and without mystery or verbosity. It is neither a primer nor a treatise; that is, neither so elementary as to reflect on the intelligence of the student nor so technical as to be beyond the average reader.

The chapters on the technique of fire and the tactical connection are worthy of especial mention, the first on account of an especially happy presentation of a subject usually assumed to be fraught with difficulty and the second because of the supreme importance of a matter as yet little developed in our service.

To touch upon all the good points of this work would require its republication here, suffice it to say that it should be in the possession of every Artillery officer, whether of the Regular Service or the National Guard, and of every other officer who ever expects to command a force including Artillery troops.

GEORGE G. GATLEY.

Efficiency of Shrapnel Fire. By Lieut. Gen. H. Rohne., German Army. Translated by permission of the author from the *Artilleristische Monatshefte* by Lieut. E. L. Gruber, 5th Field Artillery, and issued by the School of Fire.

This article, recently written by a recognized authority on Artillery fire, should be especially valuable to all Artillery officers and should not only be read but studied. It should also be interesting to any officer who may some day come under artillery fire, especially if he doubts the efficiency of shrapnel.

He discusses theoretically the effects of a single shrapnel, a group of shrapnel and their efficiency, comparing the light German field gun 1896 N/A, the light field howitzer and the French 75-millimeter gun.

The chapter on methods of fire is especially interesting to any of the many officers who have entered into or listened to the discussions on this subject, especially since the starting of the School of Fire.

The question of the unit projectile and the time shell is also discussed.

The entire article is very readable and is well illustrated with tables and figures.

J. P. W. CROREY, *Captain*, 6th Field Artillery.

St. Privat. German Sources. Compiled by Captain A. L. Conger, 26th Infantry. Translated by Master Signal Electrician Harry Bell, U. S. Army. Fort Leavenworth, Kansas: Army Service Schools. 1914. 1 vol. 2 maps. 8vo. Price, $1.00.

This collection of authoritative accounts of the operations at St. Privat on August 18, 1870, reflects great credit upon the collector, the translor and the Staff College Press. The student of history must go to original sources in order to get an accurate conception of any given event; and in the case of the action at St. Privat it would be difficult to imagine anything more accurate, more comprehensive or better arranged than the volume just published by the Army Service Schools. The action is presented in all its phases and from every point of view by many of its principal participants and from contemporaneous official reports.

The close historical study and painstaking labor involved in the compilation and translation of such a work by men in the military profession, and its publication by the press of a service school is an indication of the place which the Army Service Schools may yet hope to occupy in the educational system of the country.

It is to be hoped that the publication of *St. Privat* is but the beginning of a series of authoritative works on military history compiled by military men for military students which will not only be of the greatest value in itself, but possibly be of greater benefit to the profession by calling the attention of historians and educators to the high standard of intellectual effort which exists in our army today. In this connection it is almost superfluous to point out the fact that some well-conceived plan of coordination and cooperation is needed to prevent duplication of effort in the various service schools which at present lack adequate general supervision and direction.

War and the Empire; the Principles of Imperial Defense. By Colonel Robert Foster, R. E. London: Williams and Norgate, 1914. 1 vol. 12mo. With map, seven appendices and index. Price, 2s. 6d.

A remarkably able and prophetic interpretation of the British Empire, its component parts and the duty which each part owes to the whole. It is hard to realize that Colonel Foster's work was written prior to the great European war which has so forcibly called attention to the correctness of his premises and his reasoning.

His underlying theme is the weakness which is implied in any measures intended solely for defense and the success which invariably comes to the nation which is ever ready to take the offensive and to strike hard at the military and naval strength of the enemy. He strongly points out to the colonies that their only true defense lies in contributing freely to the common cause; and that any extensive measures for local protection are based not only upon selfishness but also upon an erroneous conception of strategy.

His disposition of the question of coast defense which has recently been the cause of so much discussion in our country may possibly seem to many readers to be the work of a man given over too frankly to the cause of the navy and the mobile army; but unprejudiced examination of the reasons

which have led Colonel Foster to pass lightly over the subject of coast defense will bring forth the fact that everything he has said is based upon historical fact and sound common sense.

At a time when all England is in daily dread of another German sea raid, Colonel Foster's explanation of the comparative insignificance of such isolated blows should be most reassuring.

Although written entirely from a British point of view and dealing exclusively with British problems, the book ought to prove a most enlightening study for Americans who have similar problems to solve, but who fortunately do not have to depend upon the initiative of self-governing colonies in order to formulate a plan for national defense.

The book shows very clearly what military and naval men in England expected of the British navy; and, in spite of many minor setbacks, it is hard to see in what particular their faith was misplaced.

Colonel Foster's residence in Washington several years ago as the British military attaché will give the book an added interest to his many friends and acquaintances.

The Modern Army in Action. By Major General John F. O'Ryan, New York National Guard, and Captain W. D. A. Anderson, Corps of Engineers, United States Army. New York: McBride, Nast and Company, 1914. 1 volume. 8vo. Price, $1.50 net. Postage, 12 cents.

The Modern Army in Action is a discussion and explanation of the entire subject of war and the waging of war. Presumably designed primarily for the purpose of enlightening those who have not before given the subject much serious thought, it is nevertheless written in such a comprehensive and concise manner as to be of considerable value to military men who may be in search of a brief exposition of the modern aspects of their profession.

The book is first concerned with an explanation of the meaning of war, its causes and its relation to society and the evolution of the human race. This exposition is followed by a historical outline of the various methods of preparing for war and preparing against war which have been characteristic of the different epochs of world history. Specific examples are given of the manner in which this problem has been met by the more important modern nations. These examples necessarily include a comparison between the scientific, thorough German preparation and the haphazard methods of England, which bear such a striking resemblance to our own lack of method in this respect.

Mobilization and concentration—terms which are so often loosely and inaccurately employed in the public press—are well defined; and the various means of transportation and supply upon which mobilization and concentration depend are enumerated and explained.

So large a question as strategy is touched upon briefly, but in an illuminating manner. Pertinent historical examples of strategical principles add greatly to the interest of the discussion.

The various main arms and branches of the service are accurately defined; and the importance and relation of the auxiliary arms are described and

discussed from a thoroughly modern point of view, and in such a manner as to clear up for the uninitiated many obscure points.

The importance of the service of security and information and the means employed to perfect it are well brought out; and the methods by which all the diverse elements of a modern army are welded together and then wielded as a single weapon are vividly and accurately described.

Although *The Modern Army in Action* is confessedly a popular discussion of professional subjects, it is so well presented that it cannot fail to have considerable value at a time when many persons, hitherto almost unconscious of the existence of an army in their own country, are suddenly finding themselves in need of brief and authoritative information on military subjects in order intelligently to follow the course of the great European conflict and to apply its lessons to our own national problem of preparedness against war.

A foreword by Major General Leonard Wood, commanding the Eastern Department, refers to these lessons in terse and unmistakable language.

EXCHANGES.

Loaned to Members on Request.

Archives Militaires, Paris, France.
Arms and The Man, Washington, D. C.
Army and Navy Journal, New York City.
Army and Navy Register, Washington, D. C.
Artilleristische Monatshefte, Berlin, Germany.
Cavalry Journal, Fort Leavenworth, Kansas.
Circular Militar Argentio, Buenos Aires, Argentine Republic.
Dansk Artileri-Tidsskrift, Copenhagen, Denmark.
Flight, London, England.
Infantry Journal, Washington, D. C.
Journal des Sciences Militaires, Paris, France.
Journal of the Military Service Institution, Governor's Island.
Journal of the Royal Artillery, Woolwich, England.
Journal of the U. S. Artillery, Fort Monroe, Virginia.
Memorial de Artilleria, Madrid, Spain.
Memorial del Estado Mayor Jeneral, Santiago, Chile.
Militar Wochenblatt, Berlin, Germany.
National Guard Magazine.
New York Sun.
New York Tribune.
Norsk Artileritidsskrift, Kristiania, Norway.
Our Dumb Animals, Boston, Massachusetts.
Professional Memoirs, Corps of Engineers, Washington, D. C.
Revista de Artilharia, Lisbon, Portugal.
Revista di Artigleria e Genio, Rome, Italy.
Revista Militar, Buenos Aires, Argentine Reupblic.
Revue d'Artillerie, Paris, France.
Revue d'Infantrie, Paris, France.

Field Artillery Directory

REGULAR ARMY

Name.	Batteries.
FIRST FIELD ARTILLERY. (Light.)	
Schofield Barracks, H. T.	
Colonel.	
Sturgis, Samuel D.	
Lieutenant Colonel.	
McMahon, John E.	
Majors.	
Cruikshank, William M.	2 Batt.
Guignard, William S.	1 Batt.
Chaplain.	
Fealy, Ignatius (1 lieut.)	
Captain.	
Cassels, Arthur F.	Adjt.
Hopkins, Frank E.	Qm.
Williams, Harry C.	E
Apple, George M.	Comy.
Mason, Roger O.	C
Browning, William S.	Adjt.
	1 Batt.
Ennis, William P.	A
Frankenberger, Samuel	Unass'd
Ferris, Charles J.	Unass'd
Rehkof, Ned B.	Adjt.
	2 Batt.
Glassford, Pelham D.	B
First Lieutenant.	
Neal, Carroll W.	E
McKinlay, Louis H.	A
Dodds, William H., Jr.	C
Huntley, Harold W.	C
Lyerly, Ballard	D
Potter, Waldo C.	A
Pfeil, Harry	Unass'd
Naylor, Harold S.	F
Marr, Harold E.	B
McCleave, William	Unass'd
Martin, Truby C.	Unass'd
Rogers, Wilbur	F
Palmer, Albert K. C.	D
Second Lieutenant.	
Gay, George S.	Qm. and comy.
	1 Batt.
Selleck, Clyde A.	C
Beard, Louie A.	B
Jones, Ivens	A
Goetz, Robert C. F.	D
Peyton, Bernard R.	F
Bowley, Freeman W.	E
Hatch, John E.	Unass'd
Andrews, Joseph	D
Deshon, Percy	F
Maxwell, Russell L.	Qm. and comy.
	2 Batt.

Name.	Batteries.
Second Lieutenant—Continued	
Winton, Walter F.	B
Daly, Joseph O.	C
Veterinarians.	
Willyoung, Lester E.	
Donovan, Andrew E.	
SECOND FIELD ARTILLERY. (Mountain.)	
Philippine Islands.	
Colonel.	
Millar, Edward A.	
Lieutenant Colonel.	
Lassiter, William	
Majors.	
Snow, William J.	Unass'd
Horn, Tiemann N.	2 Batt.
Chaplain.	
Houlihan, James F. (1 lieut.)	
Captains.	
Granger, Ralph S.	F
Stuart, Edward A.	Unass'd
Birnie, Upton, Jr.	E
Warfield, Augustus B.	D
Barnes, Joseph F.	C
Hollyday, Thomas W.	Adjt.
	2 Batt.
Mortimer, Charles G.	A
Wood, William S.	Unass'd
Allen, Charles M.	Qm.
Morrison, William F.	Adjt.
	1 Batt.
Allin, George R.	B
First Lieutenants.	
Blakely, Charles S.	A
Cubbison, Donald C.	B
Riley, James W.	C
Parker, Cortlandt	E
Lewis, Robert H.	F
Booker, Philip W.	F
Pritchett, Edwin E.	D
Rucker, William H.	E
Shepherd, William H.	B
Dunn, William E.	A
Gottschalk, Telesphor G.	Qm. and comy.
	1 Batt.
Rumbough, Joseph W.	D
Brabson, Joe R.	Qm. and comy.
Second Lieutenaunts.	2 Batt.
Wallace, Fred C.	Unass'd
Dawley, Ernest J.	E

FIELD ARTILLERY DIRECTORY—Continued

Name.	Batteries.
Second Lieutenants—Continued.	
Magruder, John	C
Riggs, E. Francis	D
Nance, Curtis H.	A
Beatty, John C.	E
Proctor, Mert	B
Meyer, Vincent	C
Wilson, Robert W.	A
Barnes, Julian F.	F
Gillespie, James A.	D
Clarkson, Herbert S.	B
Helmick, Charles G.	F
Veterinarians.	
Mitchell, Aquila	
Seeley, Burton A.	
THIRD FIELD ARTILLERY. (Light.)	
Hdqrs. and Battys. A, B, and C, Ft. Sam Houston, Tex. Battys. D, E, and F, Ft. Myer, Va.	
Colonel.	
Van Deusen, George W.	
Lieutenant Colonel.	
Menoher, Charles T.	
Majors.	
Lyon, Leroy S.	1 Batt.
McCloskey, Manus	2 Batt.
Chaplain.	
Perry, Barton W. (maj.)	
Captains.	
Stephens, John E.	A
Gallup, Fred H.	Adjt. 2 Batt.
Farrar, Henry B.	Unass'd
Austin, Fred T.	Adjt.
Donnelly, Edward T.	F
Jones, Clarence N.	E
Bunker, Charles N.	Adjt. 1 Batt. B
Hennessy, Frederick B.	D
Locke, Morris E.	C
Michel, William N.	Qm.
Myers, Joseph E.	
First Lieutenants.	
Honeycutt, Francis W.	D
Hammond, John S.	B
Carter, Arthur H.	E
Smith, Edwin De L.	B
Burleson, Richard C.	D
Olmstead, Dawson	F
Paine, George H.	E
Downer, John W.	Unass'd
Parrott, Roger S.	A
Kirkwood, Robert G.	Unass'd
Dougherty, Louis R.	A
Hopkins, Samuel R.	F
Daly, Charles D.	C

Name.	Batteries.
Second Lieutenants.	
Greble, Edwin St. J., Jr.	Unass'd
Bateman, Harold H.	A
Odell, Herbert R.	B
Simpson, Bethel W.	F
Vanderveer, Harold C.	E
Browne, Charles J.	B
Parker, Edwin P., Jr.	D
Eager, John M.	F
Brewer, Carlos	A
Cain, David E.	C
McMahon, John E., Jr.	C
Thurber, Philip L.	D
Veterinarians.	
Griffin, Gerald E.	
Gage, Fred B.	
FOURTH FIELD ARTILLERY. (Mountain.)	
Texas City, Tex.	
Colonel.	
Berry, Lucien G.	
Lieutenant Colonel.	
Irwin, Geo. LeR.	
Majors.	
Gately, George G.	2 Batt.
McMaster, Richard H.	1 Batt.
Chaplain.	
Joyce, Francis P. (capt.)	
Captains.	
Merrill, Thomas E.	E
Newbold, Henry L.	B
Spaulding, Oliver L., Jr.	F
Langdon, Jesse G.	C
Craig, Daniel P.	A
Lawson, Laurin L.	Adjt.
Brewster, Alden F.	Qm.
Kilbourne, Henry S., Jr.	D
McNair, Lesley J.	Unass'd
First Lieutenants.	
Quinn, Leo P.	Qm. and comy. 2 Batt.
Prosser, Walter E.	A
Collins, Leroy P.	F
Harlow, Charles W.	B
Greely, John N.	A
Mort, John E.	C
Barrows, Frederick M.	B
Burns, James H.	C
McBride, Allan C.	Qm. and comy. 1 Batt.
Sparks, Leonard C.	E
Hollingsworth, Charles P.	E
Stewart, Frederick W.	B
Hayden, Herbert	D

FIELD ARTILLERY DIRECTORY—Continued

Name.	Batteries.
Second Lieutenants.	
Erlenkotter, Herman	Unass'd.
Devers, Jacob L	Unass'd
Hobbs, Harvey M	Unass'd
Wrona, William J	E
Thomason, Alfred G	A
Morrow, Norman P	B
Andrus, Clift	F
Anderson, Richard E	B
Scott, Richard C	C
Eager, Howard	D
Eikel, Joe	F
Harris, Arthur R	E
Veterinarians.	
Le May, Daniel	
Power, Richard H	
FIFTH FIELD ARTILLERY. (Light.)	
Ft. Sill, Okla.	
Colonel.	
Adams, Granger	
Lieutenant Colonel.	
McGlachlin, Edward F., Jr	
Majors.	
Bowley, Albert J	2 Batt.
Bishop, Harry G	1 Batt.
Chaplain.	
Sutherland, Alexander D. (1 lt.)	
Captains.	
Smith, Wright	E
Starbird, Alfred A	Adjt.
Lanza, Conrad H	Unass'd
Moore, Dan T	Unass'd
Greene, George R	Qm.
Briggs, Raymond W	D
Kilbreth, John W., Jr	A
De Armond, Edward H	F
Wood, Norton E	C
Baker, Scott	Unass'd
Hand, Daniel W	B
First Lieutenants.	
Smith, Emery T	C
Danford, Robert M	Unass'd
Gruber, Edmund L	E
Osborne, Thomas D	Unass'd
Pennell, Ralph McT	Unass'd
Cruse, Fred T	B
Sharp, William F	E
Thorp, Frank, Jr	D
Capron, Webster A	Unass'd
Perkins, Kenneth S	A
Crane, John A	Unass'd
Prince, Frederick A	Unass'd
Second Lieutenants.	
Seaman, George G	Unass'd
Reynolds, Charles C	D

Name.	Batteries.
Second Lieutenants—Continued.	
Oliphant, Thomas G. M	Qm. and comy. 1 Batt.
Bloom, Frank	F
Jones, Lloyd E	E
Polk, Newton N	C
Hauser, John N	A
Greenwald, Karl C	B
Frankenberger, Bertram	E
Young, William C	A
Wyeth, John C	D
Burr, John G	F
Burr, William E. (addl.)	C
Veterinarians.	
Jewell, Charles H	
Sproule, William A	
SIXTH FIELD ARTILLERY. (Horse.)	
Hdqrs. and Battys. A, B, and C, Douglas, Ariz.	
Batty. D, Brownsville, Tex	
Batty. E, Laredo, Tex	
Batty. F, Eagle Pass, Tex	
Colonel.	
Greble, Edwin St. J	
Lieutenant Colonel.	
Kenly, William L	
Major.	
Aultman, Dwight E	1 Batt.
Payne, Brooke	2 Batt.
Chaplain.	
Dickson, Thomas J. (maj.)	
Captains.	
Butner, Henry W	D
Scott, Ernest D	Unass'd
Lloyd, Charles R	Adjt.
Boiseau, Louis T	B
Deems, Clarence, Jr	E
Doyle, Fred C	A
Campbell, Tilman	C
Carey, John B. W	F
Margetts, Nelson E	Unass'd
First Lieutenants.	
Bishop, Albert T	B
Starkey, John R	A
Hoyle, Rene R. De R	E
Maul, John C	Unass'd
Marley, James P	C
Merrill, Walter W	B
Tyndall, John G	F
Sands, Alfred L. P	D
George, Charles P., Jr	D
Randol, Marshall G	E
Higley, Harvey D	E
King, Edward P., Jr	F
Magruder, Marshall	C

FIELD ARTILLERY DIRECTORY—Continued

Name.	Batteries.
Second Lieutenants.	
Taliaferro, Lucien H.	F
Turner, Frank A.	B
Finch, Neil G.	C
Erwin, Vincent P.	Unass'd
Hicks, Edward H.	D
Anderson, Jonathan W.	B
Bailey, Wesley M.	A
von Holtzendorff, John D.	D
Austin, Raymond B.	E
Second Lieutenants—Continued.	
Crane, William C., Jr.	E
Sedlacek, Ernest	F
Houghton, William C.	C
Anderson, John B.	A
Veterinarians.	
Hill, William P.	
Stokes, Wilfred J.	

LINEAL RANK

No.	Name, rank, and date of rank.	Reg't.
	Colonels.	
1	*a* Adams, G. 11 mar. 11	5
2	Greble, E. St. J. 11 mar.	6
3	Treat, C. G. 6 may,	.....
4	Van Deusen, G. W. 7 sept.	3
5	Millar, E. A. 1 dec.	2
6	Sturgis, S. D. 27 dec. 12	1
7	Berry, L. G. 16 mar. 13	4
	Lieutenant Colonels.	
1	McMahon, J. E. 3 may, 11	1
2	Menoher, C. T. 26 may,	3
3	*Hinds, E.* 1 dec.	.....
4	*March, P. C* 8 feb. 12	.....
5	Kenly, W. L. 26 aug.	6
6	McGlachlin, E. F., jr. 27 dec.	5
7	Lassiter, W. 16 mar. 13	2
8	Irwin, G. Le R. 18 nov. 14	4
	Majors.	
1	*McNair, W. S.* 15 nov.	.....
2	Snow, W. J. 3 mar. 11	2
3	Gatley, G. G. 11 mar.	4
4	Lyon, Le R. S. 11 mar.	3
5	Horn, T. N. 11 mar.	2
6	*Summerall, C. P.* 11 mar.	.....
7	Cruikshank, W. M. 11 mar.	1
8	*Farr, O. W. B.* 13 apr.	.....
9	Aultman, D. E. 3 may,	6
10	*Fleming, A. S.* 26 may,	.....
11	Payne, B. 7 sept.	6
12	Guignard, W. S. 1 dec.	1
13	Bowley, A. J. 9 feb. 12	5
14	Bishop, H. G. 26 aug.	5
15	*Newbill, W. D.* 27 dec.	.....
16	McCloskey, M. 16 mar. 13	3
17	McMaster, R. H. 18 nov. 14	4
	Captains.	
1	Stephens, J. E. 23 sept.	3
2	Merrill, T. E. 23 sept.	4
3	Conner, F. 23 sept.	.....
4	Butner, H. W. 23 sept.	6
5	Newbold, H. L. 23 sept.	4
6	Scott, E. D. 23 sept.	6
7	Smith, W. 20 sept. 02	5
8	Starbird, A. A. 31 july, 03	5
9	Lloyd, C. R. 14 aug.	6
10	Spaulding, O. L., jr. 27 aug. 03	4
11	Lanza, C. H. 1 nov.	5
12	Cassels, A. F. 23 nov.	1
13	Gallup, P. H. 7 july, 04	3
	Captains.	
14	Farrar, H. B. 27 sept.	3
15	Granger, R. S. 2 feb. 05	2
16	Moore, D. T. 14 apr.	5
17	Hopkins, F. E. 24 feb. 06	1
18	Austin, F. T. 14 apr.	3
19	*Pulis C. C.* 9 june,	.....
20	Boiseau, L. T. 25 jan. 07	6
21	*Lambdin, W. McK.* 25 jan.	.....
22	Stuart, E. A. 25 jan.	2
23	Donnelly, E. T. 25 jan.	3
24	Brooke, G. M. 25 jan.	.....
25	Williams, H. C. 25 jan.	1
26	*Faulkner, A. U.* 25 jan.	.....
27	Apple, G. M. 25 jan.	1
28	*Yule, E. H.* 25 jan.	.....
29	*Westervelt, W. I.* 25 jan.	.....
30	Birnie, U., jr. 25 jan.	2
31	Deems, C., jr. 25 jan.	6
32	Doyle, F. C. 25 jan.	6
33	Jones, C. N. 25 feb. 08	3
34	*McIntyre, A.* 25 jan. 07	.....
35	Greene, G. R. 25 jan.	5
36	Briggs, R. W. 25 jan.	5
37	Bunker, C. M. 25 jan.	3
38	*Griffin, F. W.* 25 jan.	.....
39	Welsh, R. S. 25 jan.	.....
40	Campbell, T. 25 jan.	6
41	Langdon, J. G. 25 jan.	4
42	Craig, D. F. 25 jan.	4
43	Warfield, A. B. 25 jan.	2
44	Burt, W. H. 12 june,	.....
45	Hennessy, F. B. 26 july,	3
46	Lawson, L. L. 12 aug.	4
47	Locke, M. E. 25 aug. 08	3
48	Kilbreth, J. W., jr. 1 apr. 04	5
49	*Bryson, J. H.* 10 sept. 09	.....
50	Mason, R. O. 30 sept.	1
51	Browning, W. S. 15 nov. 10	1
52	Barnes, J. F. 3 mar. 11	2
53	Ennis, W. P. 11 mar.	1
54	*Currie, D. H.* 11 mar.	.....
55	*Browne, B. F.* 11 mar.	.....
56	*Pratt, R. S.* 11 mar.	.....
57	Brewster, A. F. 11 mar.	4
58	DeArmond, E. H. 11 mar.	5
59	Wood, N. E. 11 mar. 11	5
60	*Fuger, A. S.* 11 mar.	.....
61	Michel, W. N. 11 mar.	3
62	*Wheeler, E. S.* 11 mar.	.....
63	Hollyday, T. W. 11 mar.	2
64	Corey, J. B. W. 13 apr.	6
65	*Churchill, M.* 13 apr.	.....
66	*Jones, W. F.* 13 apr.	.....
67	Mortimer, C. G. 26 may,	2

(*a*) Additional in grade.

FIELD ARTILLERY DIRECTORY—Continued.

No.	Name, rank, and date of rank.	Reg't.
	Captains	
68	Margetts, N. E.....26 may,	6
69	*Davis, R.*.....7 june,	.....
70	Myers, J. E.....7 sept.	3
71	Wood, W. S.....8 sept.	2
72	Frankenberger, S.....18 oct.	1
73	Allen, C. M.....1 dec.	2
74	Morrison, W. F.....9 feb. 12	2
75	Ferris, C. J.....26 aug.	1
76	Rehkopf, N. B.....11 july, 13	1
77	Baker, S.....9 oct.	5
78	*Howze, M. W.*.....24 oct.	.....
79	Kilbourne, H. S., jr....22 nov.	4
80	McNair, L. J.....19 apr. 14	4
81	Allin, G. R.....13 june,	2
82	Glassford, P. D.....18 nov. 14	1
83	Bryden, W.....10 jan. 15	.....
84	Hand, D. W.....25 jan. 07	5
	First Lieutenants.	
1	Honeycutt, F. W.....25 jan.	3
2	Blakely, C. S.....25 jan.	2
3	Smith, E. T.....25 jan.	5
4	Danford, R. M.....25 jan.	.....
5	Quinn, L. P.....25 jan.	4
6	Gruber, E. L.....25 jan.	5
7	Neal, C. W.....25 jan.	1
8	Cubbison, D. C.....25 jan.	2
9	McKinlay, L. H.....25 jan.	1
10	Osborne, T. D.....25 jan.	5
11	*Seagrave, D.*.....25 jan.	.....
12	Dodds, W. H., jr.....25 jan.	.....
13	*Lund, J.*.....25 jan.	.....
14	Hammond, J. S.....25 jan.	3
15	Bishop, A. T.....25 jan.	6
16	Carter, A. H.....25 jan.	3
17	Prosser, W. B.....25 jan.	4
18	Riley, J. W.....25 jan.	2
19	Huntley, H. W.....25 jan.	1
20	Smith, E. De L.....25 jan.	3
21	Pennell, R. McT.....6 july, 07	5
22	*Sturgill, W. S.*.....7 july,	.....
23	*Miles, S.*.....8 july,	.....
24	Parker, C.....8 july,	2
25	Burleson, R. C.....9 july,	3
26	*Gilmor, A.*.....10 july,	.....
27	Starkey, J. R.....11 july,	6
28	Hoyle, R. E. DeR.....11 july,	6
29	Olmstead, D.....12 july,	3
30	Maul, J. C.....12 july,	6
31	*Hall, A. L.*.....13 july,	.....
32	Paine, G. H.....13 july,	3
33	Collins, L. P.....16 july,	4
34	Lyerly, B.....19 july,	1
35	Lewis, R. H.....26 july	2
36	Booker, P. W.....12 aug.	2
37	Pritchett, E. E.....5 mar. 08	2
38	Cruse, F. T.....1 july,	5
39	Marley, J. P.....20 july,	6
40	Potter, W. C.....25 aug.	1
41	Pfeil, H.....17 sept.	1
42	Merrill, W. W.....16 june, 09	6
43	Downer, J. W.....10 sept.	3
44	*Bailey, B. M.*.....29 sept.	.....
45	Sharp, W. P.....30 sept.	5
46	Thorp, F., jr.....14 jan. 10	5
47	Tyndall, J. G.....3 mar. 11	6
48	Sands, A. L. P.....11 mar.	6
49	George, C. P., jr.....11 mar.	6
50	Harlow, C. W.....11 mar.	4
51	Naylor, H. S.....11 mar.	1
52	Rucker, W. H.....11 mar.	2
53	Shepherd, W. H.....11 mar.	2
54	Randol, M. G.....11 mar.	6
55	Greely, J. N.....11 mar.	4

No.	Name, rank, and date of rank.	Reg't.
	First Lieutenants.	
56	Capron, W. A.....11 mar.	5
57	Mort, J. E.....11 mar.	4
58	Barrows, F. M.....11 mar.	4
59	Dunn, W. E.....11 mar.	2
60	Burns, J. H.....11 mar.	4
61	*Hughes, E. S.*.....11 mar.	.....
62	*Smith, T. J.*.....11 mar.	.....
63	Parrott, R. S.....11 mar.	3
64	Gottschalk, T. G.....11 mar.	2
65	Higley, H. D.....11 mar.	6
66	King, E. P., jr.....13 apr.	6
67	Perkins, K. S.....13 apr.	5
68	Kirkwood, R. G.....13 apr.	3
69	Marr, H. E.....26 may,	1
70	Rumbough, J. W.....7 june,	2
71	McCleave, W.....13 june,	1
72	McBride, A. C.....20 june,	4
73	Brabson, J. R.....20 june, 11	2
74	Sparks, L. C.....1 july,	4
75	Crane, J. A.....1 july,	5
76	Prince, F. A.....1 apr. 12	5
77	Magruder, M.....28 may,	6
78	Martin, T. C.....31 may,	1
79	Rogers, W.....31 july,	1
80	Dougherty, L. R.....22 aug.	3
81	Hopkins, S. R.....26 aug.	3
82	Hollingsworth, C. P....6 sept.	4
83	Daly, C. D.....5 mar. 13	3
84	Palmer, A. K. C.....22 Nov.	1
85	Stewart, F. W.....13 june. 14	4
86	Hayden, H.....18 nov. 14	4
87	*Ahren, L. J.*.....10 jan. 15	.....
88	Beere, D. M.....10 jan. 15	.....
	Second Lieutenants.	
1	Erlenkotter, H.....11 june,	4
2	Thummel, C. B.....11 june,	.....
3	Miner, H. E.....11 june,	.....
4	Greble, E. St. J., jr....11 june,	3
5	Devers, J. L.....11 june,	4
6	Taliaferro, L. H.....14 july,	6
7	Bateman, H. H.....14 july,	3
8	Turner, F. A.....13 nov.	6
9	Seaman, G. G.....13 nov.	5
10	Reynolds, C. C.....13 nov.	5
11	Gay, G. S.....18 jan 10	1
12	Wallace, F. C.....15 june	2
13	*Lewis, B. O.*.....15 june	.....
14	Odell, H. R.....15 june,	3
15	Selleck, C. A.....15 june,	1
16	Dawley, E. J.....15 june,	2
17	Beard, L. A.....15 june,	1
18	Jones, I.....15 june,	1
19	Goetz, R. C. F.....17 aug.	1
20	Peyton, B. R.....8 sept.	1
21	Magruder, J.....9 sept.	2
22	Riggs, E. F.....11 feb. 11	2
23	Nance, C. H.....13 june,	2
24	Bowley, F. W.....13 june,	1
25	Beatty, J. C.....13 june,	2
26	Hatch, J. E.....13 june,	1
27	*Walker, C. A., jr.*.....13 june,	.....
28	Simpson, B. W.....13 june,	3
29	Finch, N. G.....13 june,	6
30	Hobbs, H. M.....14 june,	4
31	Andrews, J.....15 june,	1
32	Oliphant, T. G. M.....20 july,	5
33	Proctor, M.....20 july, 11	2
34	Wrona, W. J.....20 july,	4
35	Erwin, V. P.....19 aug.	6
36	Bloom, F.....27 sept.	5
37	Meyer, V.....28 sept.	2
38	Hicks, E. H.....28 sept.	6
39	Thomason, A. G.....29 sept.	4

FIELD ARTILLERY DIRECTORY—Continued.

No.	Name, rank, and date of rank.	Reg't.	No.	Name, rank, and date of rank.	
	Second Lieutenants			*Second Lieutenants*	
40	Wilson, R. W..... 6 oct.	2	61	Daly, J. O.....30 nov.	1
41	Morrow, N. P..... 7 oct.	4	62	Parker, E. P., jr.....30 nov.	3
42	Jones, L. E..... 7 oct.	5	63	Eager, J. M.....30 nov.	3
43	Polk, N. N..... 7 oct.	5	64	Scott, R. C.....15 jan. 13	4
44	*Bradley, F*..... 2 dec.	.....	65	Eager, H.....25 mar.	4
45	Anderson, J. W..... 3 dec.	6	66	Young, W. C.....12 june,	5
46	Deshon, P.....24 apr. 12	1	67	Crane, W. C., jr.....12 june,	6
47	Barnes, J. F.....24 apr.	2	68	Brewer, C.....12 june,	3
48	Vanderveer, H. C.....24 apr.	3	69	Cain, D. E.....12 june,	3
49	Andrus, C.....24 apr.	4	70	McMahon, J. E., jr....12 june,	3
50	Maxwell, R. L.....12 june,	1	71	Clarkson, H. S.....26 june,	2
51	Browne, C. J.....12 june,	3	72	Eikel, J.....14 july,	4
52	Hauser, J. N.....12 june,	5	73	Helmick, C. G.....18 july,	2
53	Greenwald, K. C.....12 june,	5	74	Sedlacek, E.....30 aug.	6
54	Anderson, R. E.....12 june,	4	75	Thurber, P. L.....12 june, 14	3
55	Gillespie, J. A.....12 june,	2	76	Houghton, W. C.....12 june,	6
56	Bailey, W. M.....12 june,	6	77	Wyeth, J. C.....12 june,	5
57	von Holtzendorff, J. D.22 july,	6	78	Harris, A. R.....12 june,	4
58	Winton, W. F.....23 july,	1	79	Burr, J. G.....12 june, 14	5
59	Frankenberger, B.....30 nov.	5	80	Anderson, J. B.....12 june,	6
60	Austin, R. B.....30 nov.	6	81	Burr, W. E.....12 june,	5

MILITIA

FIRST INSPECTION DISTRICT

Capt. Robert Davis, Inspector, Boston, Mass.

Massachusetts

FIRST BATTALION

Headquarters, Boston

Maj. J. H. Sherburne.
Capt. R. F. Blake, Adjutant.

BATTERY A, BOSTON

Capt. Richard K. Hale.
1st Lieut. N. Wigglesworth.
1st Lieut. E. B. Richardson.
2nd Lieut. H. S. Allen.
2nd Lieut. R. C. Ware.

BATTERY B, WORCESTER

Capt. Edward W. Wheeler.
1st Lieut. Nicholas J. Smith.
1st Lieut. John F. J. Herbert.
2nd Lieut. Walter J. Cookson.
2nd Lieut. Arthur P. Trombly.

BATTERY C, LAWRENCE

Capt. T. D. Howe.
1st Lieut. E. O. Dick.
1st Lieut. George McLane, Jr.
2nd Lieut. W. W. Roberts.
2nd Lieut. R. A. Daniels.

Connecticut

BATTERY A, BRANFORD

1st Lieut. Frank H. Frisbie.
1st Lieut. Charles S. Yeomans.
2nd Lieut. John J. Ahern.

Rhode Island

BATTERY A, PROVIDENCE

Capt. Everitte S. Chaffee.
1st Lieut. Rush Sturgis.
1st Lieut. Wm. Gammell, Jr.
2nd Lieut. Daniel Howland.
2nd Lieut. Gerald T. Hanley.

SECOND INSPECTION DISTRICT

Capt. Dan T. Moore and Lieut. Harry Pfeil,
Inspectors, New York City

New Jersey

BATTERY A, EAST ORANGE

Capt. Claude E. Lanterman.
1st Lieut. Frederic A. Reimer.
1st Lieut. Harry P. Dickinson.
2nd Lieut. Robert B. Treat.
2nd Lieut. Edward C. James.

BATTERY B, CAMDEN

Capt. Samuel G. Barnard.
1st Lieut. William C. Hinderer.
1st Lieut. Charles M. Ferat, Jr.
2nd Lieut. Samuel R. English.
2nd Lieut. Charles H. Hinderer.

New York

FIRST FIELD ARTILLERY

Headquarters, New York City

Col. Henry H. Rogers.
Lieut. Col. Merritt H. Smith.
Capt. Dawson Olmstead, Adjutant (1st Lieut., U. S. A.).
Capt. Edwin Emerson, Commissary.

It is requested that all errors be reported to the Editor.

FIELD ARTILLERY DIRECTORY—Continued

Capt. Prentice Strong, Battalion Adjutant.
Capt. Leonard B. Smith, Battalion Adjutant.
1st Lieut. Francis D. Bowne, Battalion Quartermaster and Commissary.
1st Lieut. Alvin W. Perry, Battalion Quartermaster and Commissary.
Veterinarian Eugene Combs.

BATTERY A, SYRACUSE

Capt. Guido F. Verbeck.
1st Lieut. George G. Bailey.
1st Lieut. Thomas E. Hitchcock.
2nd Lieut. William H. Thomas.
2nd Lieut. Edward R. Granger.

BATTERY B, NEW YORK CITY

Capt. Robert D. Mills.
1st Lieut. Louis D. Fancher.
2nd Lieut. Channing R. Toy.
2nd Lieut. Walter C. McClure.

BATTERY C, BINGHAMPTON

Capt. Chas. R. Seymour.
1st Lieut. Arthur S. Douglas.
1st Lieut. John T. Shinners.
2nd Lieut. Chas. G. Blakeslee.
2nd Lieut. Arthur E. Kaeppel.

BATTERY D, NEW YORK CITY

Capt. James E. Austin.
1st Lieut. Benjamin Van Raden.
1st Lieut. Sylvester Simpson.
2nd Lieut. Frederick J. Koch.

BATTERY E, NEW YORK CITY

Capt. John T. Delaney.
1st Lieut. Frederick H. Ryan.
1st Lieut. Joseph H. de Rivera.
2nd Lieut. George B. Gibbons.

BATTERY F, NEW YORK CITY

Capt. Harold Lawson.
1st Lieut. Raymond M. Reid.
1st Lieut. Philip N. Laws.
2nd Lieut. Frederick F. Moore.

SECOND FIELD ARTILLERY

Headquarters, Brooklyn

Col. George A. Wingate.
Lieut. Col. Frank H. Hines.
Maj. Chauncey Matlock.
Maj. Joseph I. Berry.
Capt. DeWitt C. Weld, Adjutant.
Capt. Louis F. Kuntz, Quartermaster.
Capt. Wilbur T. Wright, Commissary.
Capt. Wm. B. Short, Battalion Adjutant.
Capt. Eugene F. Lohr, Battalion Adjutant.
1st Lieut. Albert D. Washington, Battalion Quartermaster and Commissary.
2nd Lieut. Herbert C. Dienst, Battalion Quartermaster and Commissary.
Veterinarian Harry F. Nimphius.
Veterinarian Robt. A. McAustin.

BATTERY A, BROOKLYN

Capt. Walter P. Fox.
1st. Lieut. John D. Butt.
2nd Lieut. Roger P. Clark.

BATTERY B, BROOKLYN

Capt. Lester C. Fox.
1st Lieut. Horst A. C. Albrecht.
2nd Lieut. Harry C. Miller.

BATTERY C, BROOKLYN

Capt. Albert S. Hamilton.
1st Lieut. Thomas A. Buys.
1st Lieut. Eugene A. Holmes.
2nd Lieut. Walter H. Simonson.

BATTERY D, NEW YORK CITY

Capt. James B. Richardson.
1st Lieut. Howard E. Sullivan.
1st Lieut. Alphonse W. Weiner.
2nd Lieut. Charles J. McGronan.

BATTERY E, NEW YORK CITY

Capt. John J. Stephens, Jr.
1st Lieut. Francis T. Colby.
1st Lieut. Robert W. Marshall.

BATTERY F, NEW YORK CITY

Capt. William O. Richardson.
1st Lieut. Samuel E. McRickard.
1st Lieut. Charles H. King.
2nd Lieut. Frederick W. Bergstein.
2nd Lieut. Raymond L. Hoffman.

THIRD INSPECTION DISTRICT

Capt. Marlborough Churchill, Inspector, Washington, D. C.

District of Columbia

1ST BATTERY, WASHINGTON, D. C.

Capt. Louis C. Vogt.
1st Lieut. George G. Wilson.
2nd Lieut. George A. Bonnet.
2nd Lieut. Harry E. Shilling.

Pennsylvania

BATTERY A, SOUTH BETHLEHEM

Capt. Thomas O. Cole.
1st Lieut. Elmer G. Tice.
1st Lieut. Carter L. Wright.
2nd Lieut. Ray R. Geary.
2nd Lieut. Herbert M. Paul.

BATTERY B, PITTSBURGH

Capt. William T. Rees.
1st Lieut. Clinton T. Bundy.
1st Lieut. John S. Puruker.
2nd Lieut. Chas. C. Williams.
2nd Lieut. Chas. C. Benton.

BATTERY C, PHOENIXVILLE

Capt. Chas. H. Cox.
1st Lieut. Frederick S. Swier.
2nd Lieut. Augustine S. Janeway.
2nd Lieut. Samuel A. Whitaker.

BATTERY D, WILLIAMSPORT

Capt. Clarence W. Kiess.
1st Lieut. William B. Reilly.
1st Lieut. John D. Andrews.
2nd Lieut. John H. Ball.

It is requested that all errors be reported to the Editor.

FIELD ARTILLERY DIRECTORY—Continued

Virginia

FIRST BATTALION

Headquarters, Richmond

Major Thomas M. Wortham.
Capt. William W. LaPrade, Adjutant.
1st Lieut. Edward S. Shields, Quartermaster.

BATTERY A, RICHMOND

Capt. William M. Myers.
1st Lieut. Edward C. Rees.
1st Lieut. James C. Pollard.
2nd Lieut. John T. Wood.
2nd Lieut. George H. Myers.

BATTERY B, NORFOLK

Capt. Robert C. Lehman.
1st Lieut. Lee F. Lawler.
1st Lieut. P. W. Kear.
2nd Lieut. McChesney H. Jeffres.
2nd Lieut. Edmond L. Sylvester.

BATTERY C, PORTSMOUTH

Capt. Lewis W. Ditto.
1st Lieut. Irvin L. Leafe.
1st Lieut. Walter J. Tennent.
2nd Lieut. Ralph O. Oliver
2nd Lieut. Robert B. MacDonald.

FOURTH INSPECTION DISTRICT

Lieut. B. M. Bailey, Inspector, Atlanta, Ga.

Alabama

FIRST BATTALION

Headquarters, Birmingham

Maj. Leon. S. Dorance.
Capt. Hartley A. Moon, Adjutant.
1st Lieut. J. Alf. Luckie, Quartermaster and Commissary.

BATTERY A, BIRMINGHAM

Capt. Frank Flinn.
1st Lieut. Walter L. Furman.
2nd Lieut. Robert L. Pittman.

BATTERY C, BIRMINGHAM

Capt. Edward L. Anderson.
1st Lieut. William S. Prichard.
1st Lieut. Julian P. Smith.

Georgia

FIRST BATTALION

Headquarters, Savannah

Maj. Richard J. Davant.
Capt. William M. Douglas, Adjutant.

BATTERY A, SAVANNAH

Capt. Edward G. Thompson.
1st Lieut. Edward G. Butler.
1st Lieut. Valentine Seyden.
2nd Lieut. Alexander R. MacDonell.
2nd Lieut. Mathias M. Ray.

BATTERY B, ATLANTA

Capt. Andrew J. McBride, Jr.
1st Lieut. John P. Hallman.
2nd Lieut. Thomas W. Jones.
2nd Lieut. Robert G. Mangum.

BATTERY C, SAVANNAH

Capt. Edward D. Wells.
1st Lieut. Joseph H. Thompson.
1st Lieut. Charles G. Lang.
2nd Lieut. Cecil Cheves.

Louisiana

FIRST BATTALION

Headquarters, New Orleans

Maj. Allison Owen.
Capt. Bryan Black, Adjutant.
1st Lieut. Joseph C. Saunders, Quartermaster and Commissary.

BATTERY A, NEW ORLEANS

Capt. James H. Beard.
1st Lieut. David L. Jamieson.
2nd Lieut. Guy L. Casseis.
2nd Lieut. William K. Nourse.

BATTERY B, NEW ORLEANS

1st Lieut. James E. Edmonds.
1st Lieut. Edwin M. Kursheedt.

BATTERY C, NEW ORLEANS

Capt. William M. Crane.
1st Lieut. Gabriel S. Adams.
1st Lieut. Stanley M. Lemarie.
2nd Lieut. Thomas M. Harllee.

FIFTH INSPECTION DISTRICT

Lieut. A. L. Hall, Inspector, Indianapolis, Indiana

Indiana

FIRST BATTALION

Headquarters, Indianapolis

Major Robert H. Tyndall.
Capt. L. Dennis Williams, Adjutant, Rockville.
1st Lieut. Frank J. Strain, Quartermaster, Rockville.

BATTERY A, INDIANAPOLIS

Capt. Gavin L. Payne.
1st Lieut. Frank W. Bushmann.
1st Lieut. Mark A. Dawson.
2nd Lieut. Chas. L. Watson.
2nd Lieut. Solon D. Carter.

BATTERY B, PURDUE UNIVERSITY, LAFAYETTE

Capt. Harry E. McIvor.
1st Lieut. Harris C. Mahin.
1st Lieut. Frank D. Dexter.
2nd Lieut. Allan D. Philips.
2nd Lieut. Joseph J. Johnston.

BATTERY C, LAFAYETTE

Capt. Thomas S. Wilson.
1st Lieut. Joseph A. Andrew.
1st Lieut. Rosier W. Levering.
2nd Lieut. John C. Doyle.
2nd Lieut. Frank Nisley.

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FIELD ARTILLERY DIRECTORY—Continued

Michigan

FIRST BATTALION

Headquarters, Lansing

Maj. Roy C. Vandercook.
Capt. Labon K. Caster, Adjutant.
2nd Lieut. Robert E. Marsh, Quartermaster.

BATTERY A, LANSING

Capt. Chester B. McCormick
1st Lieut. Amos H. Ashley.
1st Lieut. Edwin Spies.
1st Lieut. Fred G. Fuller.
2nd Lieut. F. G. Chaddock.

BATTERY B, LANSING

Capt. Donald M. Childs.
1st Lieut. Frank P. Dunnebacke.
2nd Lieut. Chester E. Boelio.
1st Lieut. Joseph H. Lewis.

Ohio

FIRST BATTALION

Headquarters, Briggsdale

Maj. H. M. Bush.
Capt. Carl H. Hirstius, Adjutant.
1st Lieut. Harry R. Avery, Battalion Quartermaster and Commissary.

BATTERY A, CLEVELAND

Capt. Quida A. Kulish.
1st Lieut. Fred T. Mudge.
1st Lieut. Everete C. Williams.

BATTERY C, BRIGGSDALE (COLUMBUS)

Capt. Rodney E. Pierce.
2nd Lieut. George H. Bartholomew.
2nd Lieut. Lawrence S. Schlegel.

BATTERY D, MT. VERNON

2nd Lieut. Robert D. Dowds.
2nd Lieut. Vincent B. Welker.
Veterinarian, Frank R. Lunn.

SIXTH INSPECTION DISTRICT

Lieut. Louis R. Dougherty, Inspector, Chicago, Illinois

Illinois

FIRST BATTALION

Headquarters, Waukegan

Maj. Ashbel V. Smith.
Capt. George H. Gould, Adjutant.
1st Lieut. William J. Garard, Quartermaster and Commissary.

BATTERY A, DANVILLE

Capt. Orvill F. Hopper.
1st Lieut. Harvey J. McMillan.
1st Lieut. Fred Starkey.
2nd Lieut. Leslie P. Livengood.

BATTERY B, CHICAGO

Capt. Frank M. Course.
1st Lieut. Max. E. Payne.
1st Lieut. J. B. Weintraub.
2nd Lieut. James P. Tyrell.

BATTERY C, WAUKEGAN

1st Lieut. Joseph R. Durkin.
1st Lieut. Fred C. Morey.
2nd Lieut. Philo J. Burgess.
2nd Lieut. Edward E. Barclay.

Wisconsin

BATTERY A, MILWAUKEE

Capt. Philip C. Westfahl.
1st Lieut. Alonzo J. Comstock.
1st Lieut. John G. Reed.
2nd Lieut. William P. Fraedrich.
2nd Lieut. Alvin A. Knechenmeister.

Iowa

BATTERY A, CLINTON

Capt. George W. Dulany, Jr.
1st Lieut. Jacob E. Brandt.
1st Lieut. James L. Oakes.
2nd Lieut. Eugene J. Curtis.
2nd Lieut. Martin Purcell.

SEVENTH INSPECTION DISTRICT

Lieut. Frank Thorp, Inspector, Kansas City Mo.

Kansas

BATTERY A, TOPEKA

Capt. Clarence G. Grimes.
1st Lieut. Martin C. Pennekamp.
1st Lieut. Dana T. Jennings.
2nd Lieut. Frank E. Barnard.
2nd Lieut. Charles E. Edwards.

Missouri

BATTERY A, ST. LOUIS

1st Lieut. Walter J. Warner.
2nd Lieut. Edwin R. Niehaus.

BATTERY B, KANSAS CITY

Capt. Arthur J. Elliott.
1st Lieut. Roy T. Olney.
2nd Lieut. Harry W. Ruttinger.
2nd Lieut. Herman H. Kube.

BATTERY C, INDEPENDENCE

Capt. Edward N. Stayton.
1st Lieut. John L. Miles.
1st Lieut. Spencer Salisbury.
2nd Lieut. Harry B. Allen.
2nd Lieut. George W. Cassell.

Texas

BATTERY A, DALLAS

Capt. F. A. Logan.
1st Lieut. A. C. Allen.
1st Lieut. Sanford A. Stewart, Jr.
2nd Lieut. Fred W. Logan.

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FIELD ARTILLERY DIRECTORY—Continued

EIGHTH INSPECTION DISTRICT

Lieut. W. P. Sharp, Inspector, Denver, Colorado

Colorado

BATTERY A, DENVER

Capt. John B. Goodman, Jr.
1st Lieut. John P. Donovan.
2nd Lieut. Harry O. Nichols.

BATTERY B, DENVER

Capt. Joseph W. LeFever.
2nd Lieut. William H. Schade.
2nd Lieut. George P. Hopkins.
2nd Lieut. Earl L. Edwards.

New Mexico

BATTERY A, ROSWELL

Capt. Charles M. De Bremond.
1st Lieut. James C. Hamilton.
1st Lieut. Willard F. Hird.
2nd Lieut. George M. Williams.

Utah

1ST BATTERY, SALT LAKE CITY

Capt. William C. Webb.
1st Lieut. Curtis Y. Clawson.
2nd Lieut. Paul W. Billings.

NINTH INSPECTION DISTRICT

Capt. E. H. Yule, Inspector, San Francisco, Cal.

California

FIRST BATTALION

Headquarters, Oakland

Maj. Ralph J. Faneuf.
Capt. Frederick W. H. Peterson, Adjutant.
1st Lieut. John S. Riley, Quartermaster and Commissary.

BATTERY A, LOS ANGELES

Capt. Reuben A. Ford.
1st Lieut. Jesse McComas.
1st Lieut. Samuel C. Haver, Jr.
2nd Lieut. Harry L. Powell, Jr.
2nd Lieut. Plummer H. Montgomery.

BATTERY B, OAKLAND

Capt. Harry F. Huber.
1st Lieut. Charles J. Hogan.
1st Lieut. Edward E. Vicary.
2nd Lieut. John W. White.
2nd Lieut. Howard W. Enefer.

BATTERY C, STOCKTON

Capt. Harry N. Howe.
1st Lieut. Otto E. Sandman.
2nd Lieut. Charles H. Young.
2nd Lieut. Asa M. Clark.

Oregon

BATTERY A, PORTLAND

Capt. Hiram U. Welch.
1st Lieut. George B. Otterstedt.
1st Lieut. Bert V. Clayton.
2nd Lieut. Charles L. Johnson.

STATE OF MINNESOTA

Capt. C. C. Pulis, Inspector, St. Paul, Minn.

FIRST FIELD ARTILLERY

Headquarters, St. Paul

Col. George C. Lambert.
Lieut. Col. William J. Murphy.
Maj. Gates Johnson, Jr., First Battalion.
Maj. George M. Leach, Second Battalion.
Capt. Otto N. Raths, Adjutant.
Capt. Fred L. Baker, Quartermaster.
Capt. William H. Donahue, Commissary.
Capt. Chas. A. Green, Adjutant, 2nd Battalion.
1st Lieut. John H. Shoemaker, Quartermaster. 2nd Battalion.
2nd Lieut. James K. Scott, Jr., Quartermaster. 1st Battalion.

BATTERY A, ST. PAUL

Capt. Arthur G. Feuchert.
1st Lieut. John Hammerbacher.
1st Lieut. Henry A. Stempel.
2nd Lieut. Otto K. Seidel.

BATTERY B, ST. PAUL

Capt. Frederick A. Tiffany.
2nd Lieut. Theodore A. Kuldunski.

BATTERY C, ST. PAUL

Capt. Thomas J. O'Leary.
1st Lieut. John H. McDonald.
1st Lieut. Roger J. Finn.
2nd Lieut. Philip J. McCauley.

BATTERY D, MINNEAPOLIS

1st Lieut. Douglas G. Burrill.
2nd Lieut. Ernest J. Wenburg.

BATTERY E, MINNEAPOLIS

Capt. James E. Jensen.
1st Lieut. William S. Hale.

BATTERY F, MINNEAPOLIS

Capt. Walter F. Rhinow.
1st Lieut. John J. Tooffe.
1st Lieut. Fletcher Rockwood.
2nd Lieut. William H. Kennedy.

UNASSIGNED

New Hampshire

BATTERY A, MANCHESTER

Capt. Edwin L. Towle.
1st Lieut. Frank J. Abbott.
1st Lieut. Henry A. Worthen.
2nd Lieut. Lucius E. Hill.
2nd Lieut. George W. Upton.

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FIELD ARTILLERY DIRECTORY—Continued

ACTIVE MEMBERSHIP, FIELD ARTILLERY ASSOCIATION.

Regular Army.

Unassigned to regiments	92 per cent.
3rd Field Artillery	88 per cent.
4th Field Artillery	79 per cent.
6th Field Artillery	79 per cent.
2nd Field Artillery	78 per cent.
1st Field Artillery	76 per cent.
5th Field Artillery	70 per cent.

Militia.

New Mexico	100 per cent.
Rhode Island	100 per cent.
Utah	100 per cent.
Massachusetts	76 per cent.
Ohio	75 per cent.
Indiana	67 per cent.
Missouri	64 per cent.
Pennsylvania	53 per cent.
Virginia	43 per cent.
Michigan	42 per cent.
Illinois	33 per cent.
Connecticut	33 per cent.
Texas	25 per cent.
District of Columbia	25 per cent.
New York	22 per cent.
Minnesota	21 per cent.
Wisconsin	20 per cent.
New Jersey	20 per cent.
Iowa	20 per cent.
Louisiana	15 per cent.
Colorado	14 per cent.
Alabama	10 per cent.
California	12 per cent.
Georgia	7 per cent.
Kansas	0 per cent.
New Hampshire	0 per cent.
Oregon	0 per cent.

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